BLM LIBRARY
88070646

Final

ENVIRONMENTAL ANALYSIS RECORD
and Technical Report

NV-050-6-57

Oil, Gas and Geothermal Leasing

Covering the

Caliente and Virgin Valley

Planning Units

Clark and Lincoln Counties, Nevada

Bureau of Land Management

Las Vegas District Office

Las Vegas, Nevada

Prepared by: Denise Meridith
Environmental Coordinator

and

Howard Wirtz
Geologist

June, 1976

CALI
.46
EAR

PROPERTY OF
Bureau of Land Management
DSC LIBRARY

#924843725 ID88070646 CALI .46 EAR HD 243 .N3 M47 1976

Table of Contents

Page

PROPERTY OF
Bureau of Land Management
DSC LIBRARY

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

<u>Maps</u>

Tables

I. Introduction

As a result of the energy crises facing the United States, there has been a push to find new sources of energy throughout the country. Oil and gas are old and familiar standbys, but geothermal exploitation has received only scant attention until recently. In 1970, the President signed the Geothermal Steam Act into law. This law authorized the Secretary of the Interior to issue leases for the development and utilization of geothermal steam and associated geothermal resources. In 1973, the "Environmental Statement of the Geothermal Leasing Program" was released. One of the recommendations in this E.I.S. was that the impacts of geothermal leasing in specific areas be evaluated in environmental analysis records (E.A.R.'s).

This E.A.R. covers the Caliente and Virgin Valley Planning Units (see Maps #1 and #2). The study area is large; it extends from Township 1 N. to 21 S. and from Range 54 E. to 71 E. The E.A.R. discusses the effects that oil, gas and geothermal leasing will have on living and non-living components, human values and ecological interrelationships in this area of Nevada.

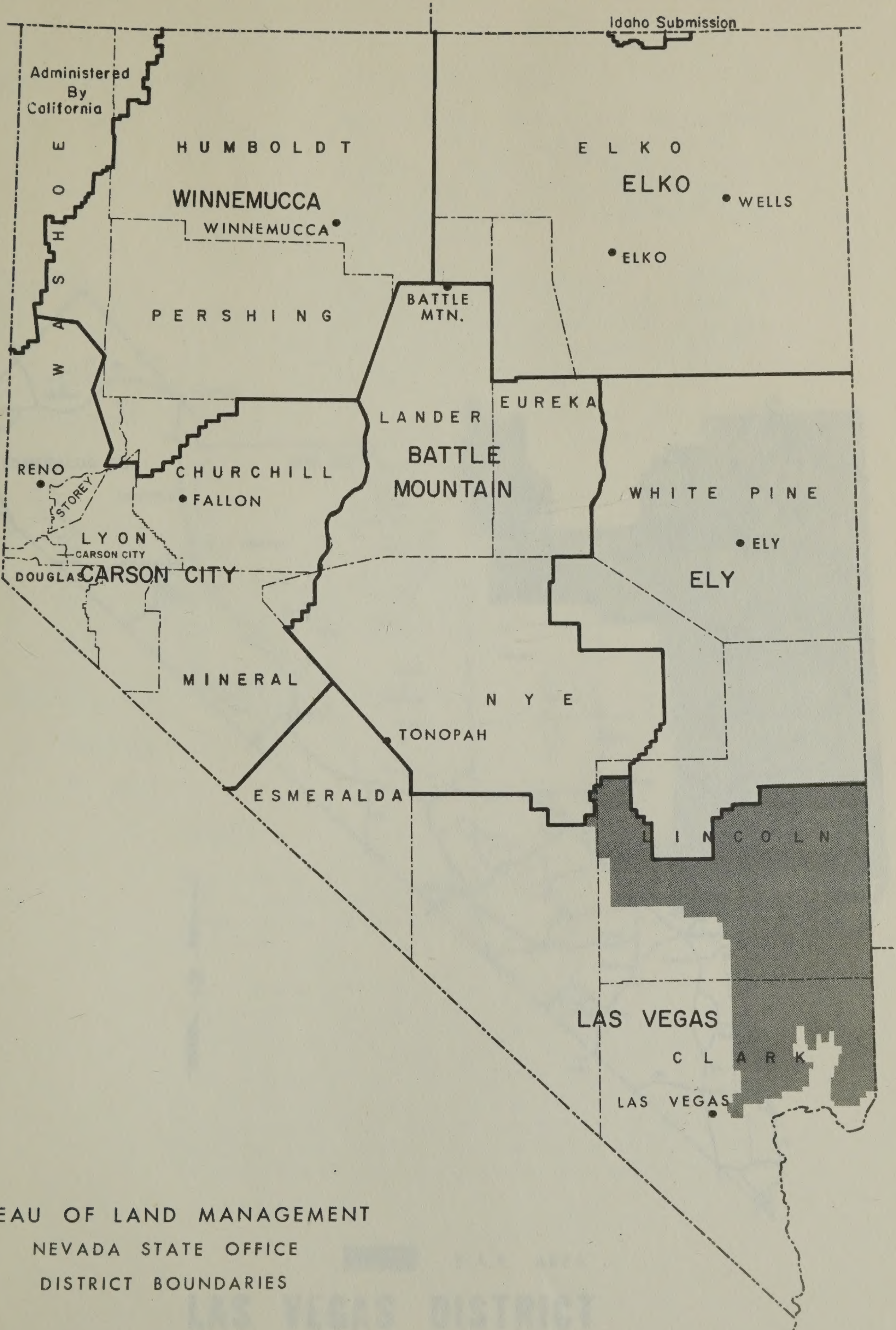
II. Description of the Proposed Action and Alternatives

A. Proposed Action

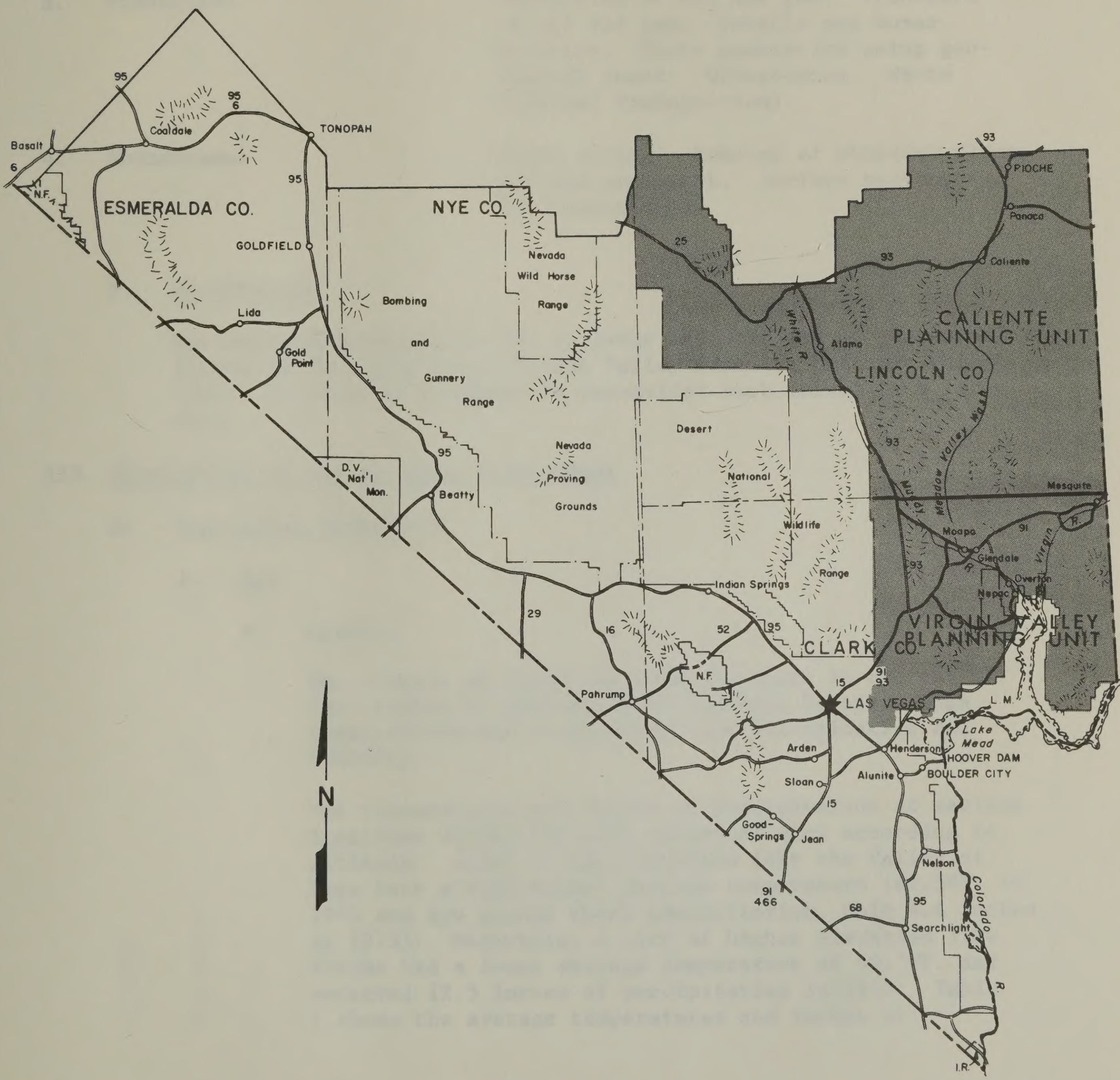
The proposed action involves the issuing of exploration permits, "Notices to Conduct Geothermal Resource Explorations" and the issurance of leases for oil, gas and geothermal resource development. The leases and permits would be subject to the general lease terms and general surface disturbance stipulations which are routinely incorporated, as well as any special stipulations and restrictions necessary to insure that the work is done in an environmentally sound manner.

The proposed action would result in the following stages of implementation and discrete operations:

Stages of Implementation	Discrete Operations
1. Exploration	
Phase 1: Reconnaissance and Geophysical Studies (Pre-lease geothermal, Post-lease O & G)	Surveys, mapping, drilling of shallow holes. Off-road vehicle travel. No rehabilitation needed.
Phase 2: Deep drilling (Wildcat) (Post lease)	Road construction. Drilling operation. Earth moving. Rehabilitation, if unsuccessful.



BUREAU OF LAND MANAGEMENT
NEVADA STATE OFFICE
DISTRICT BOUNDARIES



E.A.R. AREA

LAS VEGAS DISTRICT

MAP #2

Stages of Implementation	Discrete Operations
2. Development	Road & trail construction and improvement. Drilling (large scale earth moving). Vehicle and human activity. Plant construction and development. Construction camp. Transmission lines or pipe lines.
3. Production	Extraction of oil and gas. Transport of oil and gas. Vehicle and human activity. Power generation using geothermal power. Maintenance. Waste disposal (reinjection).
4. Abandonment	Earth moving. Removal of physical plant, men and equipment. Surface reclamation and restoration.

B. Alternative

The major alternative is not to issue any oil, gas or geothermal leases in the Caliente or Virgin Valley Planning Units at this time. It would be possible to reconsider such leases at a later date.

III. Description of the Existing Environment

A. Non-Living Components

1. Air

a. Climate

The climate of these two planning units is typical of the climate of most areas in southern Nevada: high temperatures and evaporation, low precipitation and humidity.

The temperatures and amount of precipitation at various locations within the area concerned vary according to altitude. Areas of low elevation like the Valley of Fire have a high annual average temperature (67.5°F. in 1973 and low annual total precipitation, only 4.4 inches, in 1973). Meanwhile, a city of higher elevation like Pioche had a lower average temperature of 49.7°F. and received 12.5 inches of percipitation in 1973. Table 1 shows the average temperatures and inches of

Table 1

Climatological data

Station	J	F	M	AP	MY	JUN	JY	AUG	S	O	N	D	Annual
	Av. Temp (degrees)												
Caliente	30.8	37.6	40.6	49.9	63.3	70.3	77	74.5	64	54.3	41.9	36	53.4
Pioche	26.7	33.3	33.8	44.4	58.9	66.5	73.4	71.5	62.1	53.1	38.7	33.8	49.7
Elgin	38.4	45.7	47.0	56.3	70.5	70.9	83.8	81.5	----	64.3	48.2	44.7	----
Logandale	40.4	50.1	50.6	58.8	73.4	79.4	85.1	84.2	75.6	65.8	51.8	95.4	63.4
Pahranagat Wild-life Refuge	36.4	44.2	44.8	54.9	67.8	74.1	81.1	77.8	68.8	59.4	44.9	40.5	57.9
Valley of Fire	41.2	50.8	52.3	63.2	76.0	86.6	94	90.5	81 8	70.7	54.2	48.1	67.5

Station	J	F	M	AP	MY	JUN	JY	AUG	S	O	N	D	Annual
	Precipitation (inches)												
Caliente	.77	1.3	3.08	1.48	.48	.17	.71	1.12	----	.32	.47	.31	10.21
Pioche	1.7	2.52	3.29	1.46	.38	.90	.82	.35	T	.12	.52	.45	12.5
Elgin	2.59	3.16	3.69	.61	.23	.59	.43	.87	0	.69	1.09	.44	14.39
Logandale	.38	1.15	1.96	.33	.09	.18	0	.15	0	.12	.11	.22	4.69
Pahranagat Wild-life Refuge	.37	1.12	2.82	.92	.39	.39	0	.33	.15	.16	.41	.08	7.14
Valley of Fire	.35	1.42	1.94	0	.12	.12	0	.09	0-	.22	.14	T	4.4

U. S. Dept. of Commerce, 1973

precipitation for various locations within the study area in 1973. Maps #3, 4 and 5 show precipitation, mean minimum and maximum temperatures over the period 1931-55.

The relative humidity is usually low - 20 to 40% during the winter and only 3-15% during the summer.

High winds can accompany summer thermal low pressure areas or winter fronts. Gusts up to 50 m.p.h. can occur at such times. During the summer, nearly 70% of the winds are southwesterly while in the winter only about 30% are.

Due to a combination of high temperatures, high winds and low humidity, evaporation rates are high, especially at low elevations. Evaporation usually averages about 120 inches per year at low elevations and 50-70 inches per year at higher elevations.

b. <u>Air Quality</u>

The following are the air quality standards for the State of Nevada adopted by the Commission of Environmental Protection and approved by the Environmental Protection Agency.

The following air contaminant concentrations shall not be exceeded at any single point in the ambient air:

Sulfur oxides as sulfur dioxide
- Annual arithmetic means. . . . . 60 ug/M^3 (.02 ppm)
- Maximum 24 hour concentration. . 260 ug/M^3 (0.1 ppm)
- Maximum 3 hour concentration. . . 1,300 ug/M^3 (0.5 ppm)

Particulate Matter
- Annual geometric mean. . . . . . 60 ug/M^3
- Maximum 24 hour concentration. . 150 ug/M^3

Carbon monoxide
- Maximum 8 hour concentration . . 10,000 ug/M^3 (9.0 ppm)
- Maximum 1 hour concentration . . 40,000 ug/M^3 (35.0 ppm)

Photochemical oxidant
- Maximum 1 hour concentration . . 160 ug/M^3 (.08 ppm)

Hydrocarbons (non-methane fraction)
- Maximum 3 hour concentration between 6:00 a.m. and 9:00 a.m. . . . . 160 ug/M^3 (0.24 ppm)

precipitation for various locations within the study area in Table. Maps 13, 14 and 15 show precipitation, mean minimum and maximum temperatures over the period 1931-60.

The relative humidity is usually low - 20 to 40% during the winter and about 5-15% during the summer.

High winds and extremely short storms are generally areas of winter fronts. Gusts up to 70 m.p.h. can occur at such times. During the summer, nearly 50% of the winds are predominantly calm; in the winter only about 30% are.

Due to a combination of high temperatures, high winds and low humidity, evaporation rates are high, especially at low elevations. Evaporation generally averages about 120 inches per year at low elevations and 50-60 inches per year at higher elevations.

B. Air Quality

The following are the air quality standards for the State of Nevada adopted by the Department of Environmental Protection and approved by the Environmental Protection Agency.

The following air contaminant concentrations shall not be exceeded at any single point in the ambient air:

Sulfur oxides as sulfur dioxide
 Annual arithmetic mean . . . . . 60 $\mu g/m^3$ (.02 ppm)
 Maximum 24 hour concentration . . 260 $\mu g/m^3$ (0.1 ppm)
 Maximum 3 hour concentration . . 1,300 $\mu g/m^3$ (0.5 ppm)

Particulate Matter
 Annual geometric mean . . . . . 60 $\mu g/m^3$
 Maximum 24 hour concentration . . 150 $\mu g/m^3$

Carbon Monoxide
 Maximum 8 hour concentration . . 10,000 $\mu g/m^3$ (9.0 ppm)
 Maximum 1 hour concentration . . 40,000 $\mu g/m^3$ (35.0 ppm)

Photochemical Oxidants
 Maximum 1 hour concentration . . 160 $\mu g/m^3$ (.08 ppm)

Hydrocarbons (Non-methane fractions)
 Maximum 3 hour concentration between
 6:00 a.m. and 9:00 a.m. . . . . 160 $\mu g/m^3$ (0.24 ppm)

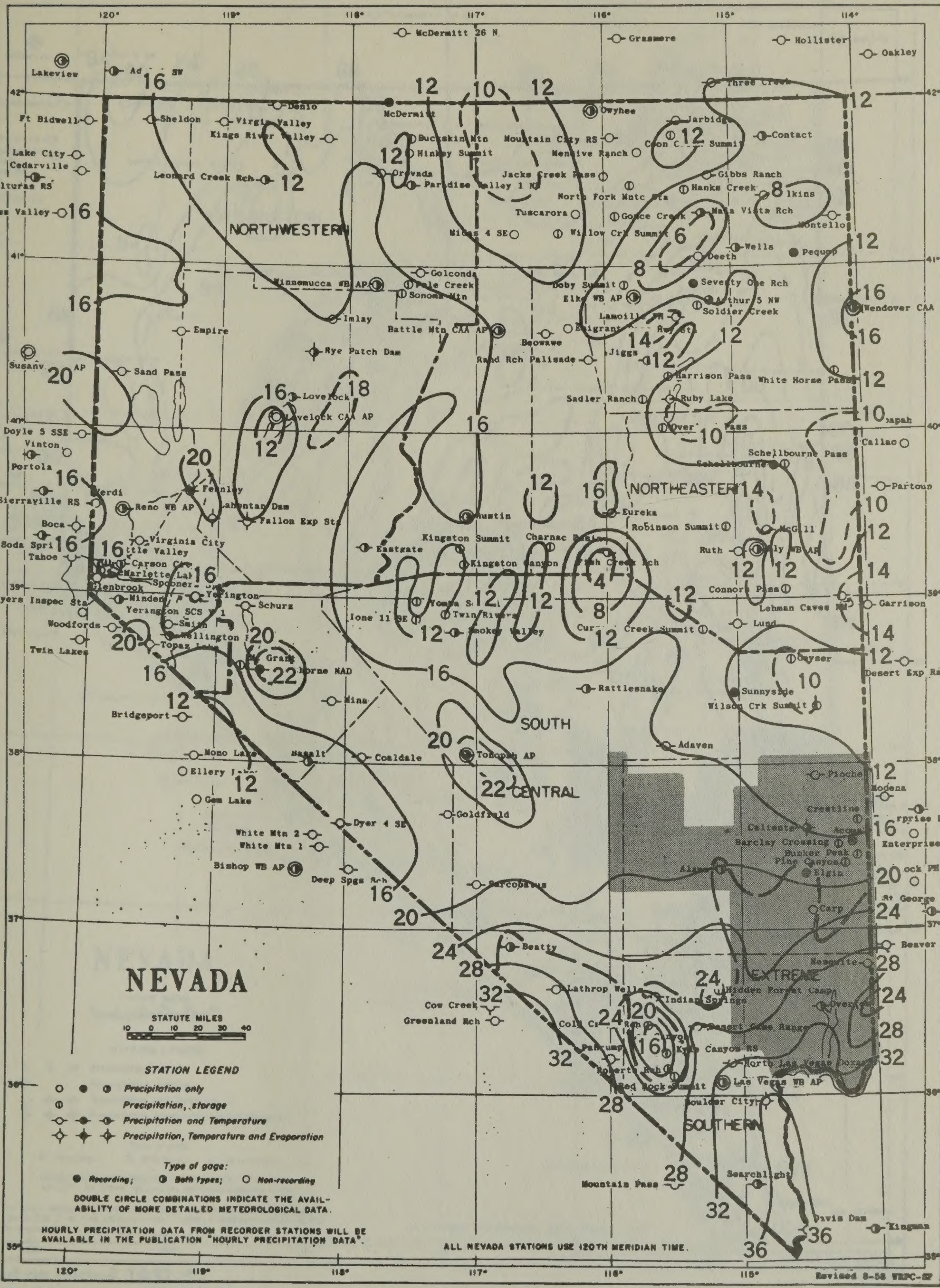
Mean Annual Precipitation, Inches MAP #3

Based on period 1931-55

Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

E.A.R. AREA

Mean Minimum Temperature (°F.), January MAP #4



Based on period 1931-52

Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

E.A.R. AREA

Mean Maximum Temperature (°F.), July

MAP #5

Based on period 1931-52

Isolines are drawn through points of approximately equal value. Caution should be used in interpolating on these maps, particularly in mountainous areas.

E.A.R. AREA

Nitrogen dioxide
Annual arithmetic mean. . . . 160 ug/M^3 (.05 ppm)

All values corrected to reference conditions.

Definitions:

ug/M^3 - micrograms per cubic meter
ppm - parts per million by volume

Clark County Standards (portion of the Virgin Valley Planning Unit) are as follows:

(1) Smoke

(a) No more than 10% light diminishment regardless of color.

(b) Motor vehicles shall not emit smoke while moving for a distance of more than 100 yards.

(2) Fugitive Dust

Must not create a hazard and must not cross property lines.

(3) Particulate Matter

0.00407 lbs./hr. per 10 lbs. of refuse burned.
0.046 lbs./hr. per 10 lbs. of material processed by an industry.

(4) Sulfur Dioxide

150 lbs. per billion BTU/hr. Applicable to power generating plants.

The air quality throughout most of the study area is good except during high winds when dust is a problem. The exceptions result from the following sources of pollution:

Reid Gardner Generating Station
Apex Limestone Plant
Johns Manville Plant
Exhausts from automobiles on major highways
Agricultural burning
Off-road vehicle events

These activities can temporarily increase concentrations of carbon monoxide, smoke, particulate and fugitive dust in the atmosphere.

An inversion layer sometimes also forms over sections of the Virgin Valley Planning Unit bordering Las Vegas Valley. As the population of the metropolis grows and spreads into neighboring areas, this problem may grow worse.

2. Lands

a. Physiography

The Caliente-Virgin Valley Resource Area comprises the northern part of Clark County and the southern part of Lincoln County. It is bounded by the Lake Mead Recreation Area on the south, the Arizona and Utah State lines on the east, the Ely BLM District on the north, and the Nellis Air Force Range and Desert Game Range on the west.

The region is part of the Basin and Range Physiographic Province characterized by elongate north-south trending fault-block mountain ranges separated by alluvial-filled valleys. The ranges are made up mostly of sedimentary rocks of Paleozoic and Mesozoic age that have been titled, usually in a "hinge" fashion with frequent low-angle thrust faults. Later normal faulting form the block-faulted ranges. The Virgin and Clover Mountains have older Precambrian metamorphic cores exposed. Limestone and dolomite (carbonate rocks) form 75-80 percent of the sediments in the mountain ranges. Major folding and faulting in Cretaceous times followed by intensive intrusion of granitic rocks left the land surface essentially in its present structural form. Sediments were extensively deposited (Gale Hills Formation) in the southern part of the region south of the Muddy Mountains during the late Cretaceous. Also, the Horse Spring Formation of Cenozoic Age, covers much of the surface in the southern part of the Resource Area.

b. Soils

Soil Depth

Soils of the areas encompassed by this EAR range in depth from very shallow (4 to 10 inches) to bedrock or caliche hardpan on steep mountain slopes, plateaus, and alluvial fans to very deep (greater than 60 inches) on the playas. Very shallow soils and rock land occur on very steep canyon walls, escarpments, and dissected portions of lava plateaus where vegetative cover density is less than 4%.

Soil Structure

Soil structure refers to the aggregation of primary soil particles into compound particles which are separated from adjoining aggregates by surfaces and weaknesses. Aggregates differ in shape, in size, in stability, and in adhesion to one another. Structures range from single-grained granular sands to plastic platy clays underlying the playas.

The texture of soils refers to the relative size of individual particles and is an expression of the relative percentages of sand, silt, and clay in the soil. Surface textures are predominately coarse loamy sands, moderately coarse sandy loams, and medium textured loams and silt loams. Subsoil textures are sandy loams, silt loams, loams, and moderately fine clay loams. Large amounts of stone, cobbles and gravel are prevalent in alluvial fan and steep upland soils.

Soil Nutrient Properties

The soils are generally low in natural nutrient properties, as evidenced by sparse vegetative cover over most of the area. The soils are generally alkaline with a pH range from 7.0-8.5. Water is drawn up through the soil profile in thin capillary pathways from the water table. As the water evaporates, the soluble salts become concentrated at or near the surface, characterized by a white film or crust.

Soil Erosion

Accelerated erosion involves two processes - the detachment or loosening influence followed by transportation by means of floating, rolling, dragging, and splashing. Freezing and thawing, flowing water, and rain impact provide the detaching agents. Raindrop splash and especially running water facilitate the carrying away of loosened soil. On comparatively smooth soil surfaces, the beating of raindrops affect most of the detachment.

During the high intensity, short duration thundershowers that are common in the region, raindrop impact tends to destroy soil granulation, encourage sheet and rill erosion and also considerable transportation by splashing. If the dispersed material is not removed

by runoff, a hard crust develops upon drying. This crust impedes seedling emergence, greately reduces capillary infiltration for the next storm, and limits the possibilities for vegetative cover. As a protective influence, the vegetative shield, by absorbing the energy of rain impact, prevents the loss of both water and soil and reduces degranulation to a minimum. In Dry Lake Valley, the generally sparse vegetative cover provides for little interception of precipitation or protection from overland flow of water.

As is the case for water erosion, the loss of soil by wind movement also involves detachment and transportation. The abrasive action of the wind results in some detachment of tiny soil grains from the granules or clods of which they are a part. When the wind is laden with soil particles its abrasive action is greatly increased. The impact of these rapidly moving grains dislodges other particles from soil clods and aggregates. The cutting and abrasive effects, especially of sand, upon tender leaves and vegetation is disasterous.

The watershed section of the URA has identified areas having high erosion potential or current land use that is increasing the erosion rate. Restricted use could provide the opportunity for erosion prevention by limiting or excluding such activities as construction and off-road vehicle use. Such action would allow the soil resource to maintain itself and build a better resistance to erosion by formation of a desert pavement. Improved water quality would be promoted by reducing the sediment load in surface water and by increasing resistance to overland flow by maintaining or increasing vegetative growths (see maps 6 & 7 for restricted use areas).

Flood and Sediment Damage

Flood and sediment damage results from high intensity, short duration thundershowers as mentioned previously in the soil erosion section of the EAR. Damage varies from gully cutting and overland flow on National Resource Lands to road and highway, agricultural, and residential damage.

In Upper and Lower Moapa Valley, flood and sediment damage has caused loss of agricultural lands, crops, railroad tracks, roads and highways. Damage in varying degrees has occurred to homes, waterlines, irrigation canals, and fencing equipment. Source area contribution appears to come from highly erosive, low productive capacity National Resource Lands. Damage-producing storms occur yearly in the area.

by runoff, a hard crust develops upon drying. This crust impedes seedling emergence, greatly reduces capillary infiltration of the soil water, and limits the possibilities for vegetative cover. As a protective measure, the vegetative shield, by absorbing the energy of rain impact, prevents the loss of both water and soil and reduces downstream sediment problems. In dry lake valleys, the generally sparse vegetative cover provides but little interception of precipitation or protection from overland flow of water.

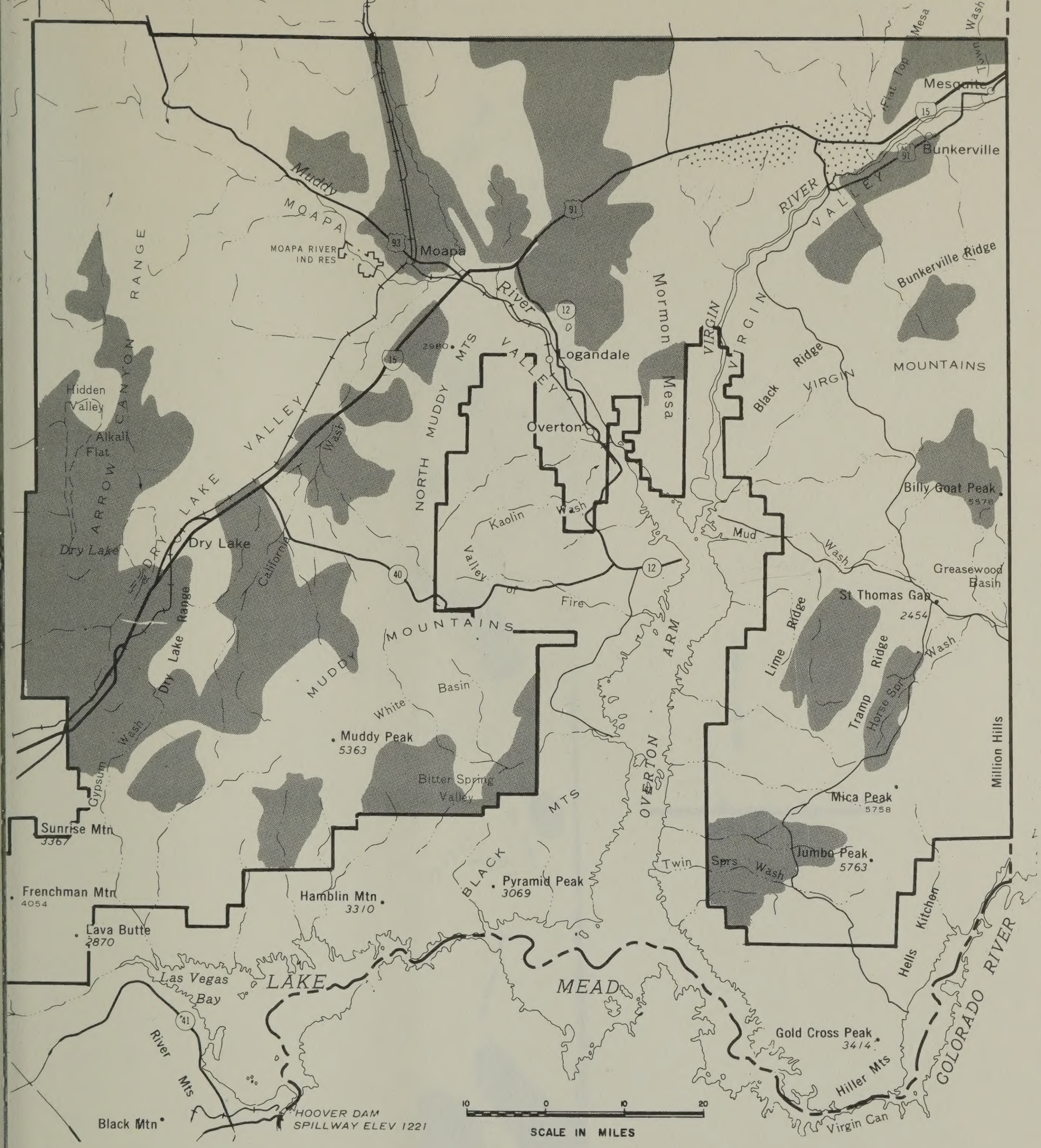
As is the case for water erosion, the loss of soil by wind movement also involves detachment and transportation. The abrasive action of the wind results in some detachment of individual grains from the aggregates or clods of which they are a part. When the wind is laden with soil particles the detaching action is greatly increased. The impact of these rapidly moving grains dislodges other particles from aggregates and vegetation. The cutting and abrasive effects, a property of sand, upon tender leaves and vegetation is often severe.

The watershed treatment of the ORV use identified areas having high erosion potential or current loss and that is currently the activity area. Restrictions of ORV use could prevent the continuation for erosion processes by limiting or restricting ORV activities or construction and off-road use. Such action would allow the soil surfaces to stabilize, heal and build a better resistance to erosion by formation of a desert pavement. Improved water quality would be provided by reducing the sediment load in surface water and by increasing resistance to overland flow by natural means (increasing vegetative growth (see Appendix A-7) on re-closed use areas).

Flood and Sediment Damage

Flood and sediment damages results from high intensity, short duration storms as mentioned previously in the soil erosion section of the EAR. Damage varies from gully cutting and sedimentation on National Resource Lands to road and highway, agricultural and residential damage.

In Dumont and Lower Kelso drainages, flood and sediment damage has caused loss of agricultural lands, sites, railroad tracks, roads and highways. Damage to surface deposits and ruins of early water-based irrigation canals, and historic settlements. Further site consolidation expected to come from high intensity for productive capacity National Resource Lands. Nongeomorphic storms occur yearly in the area.

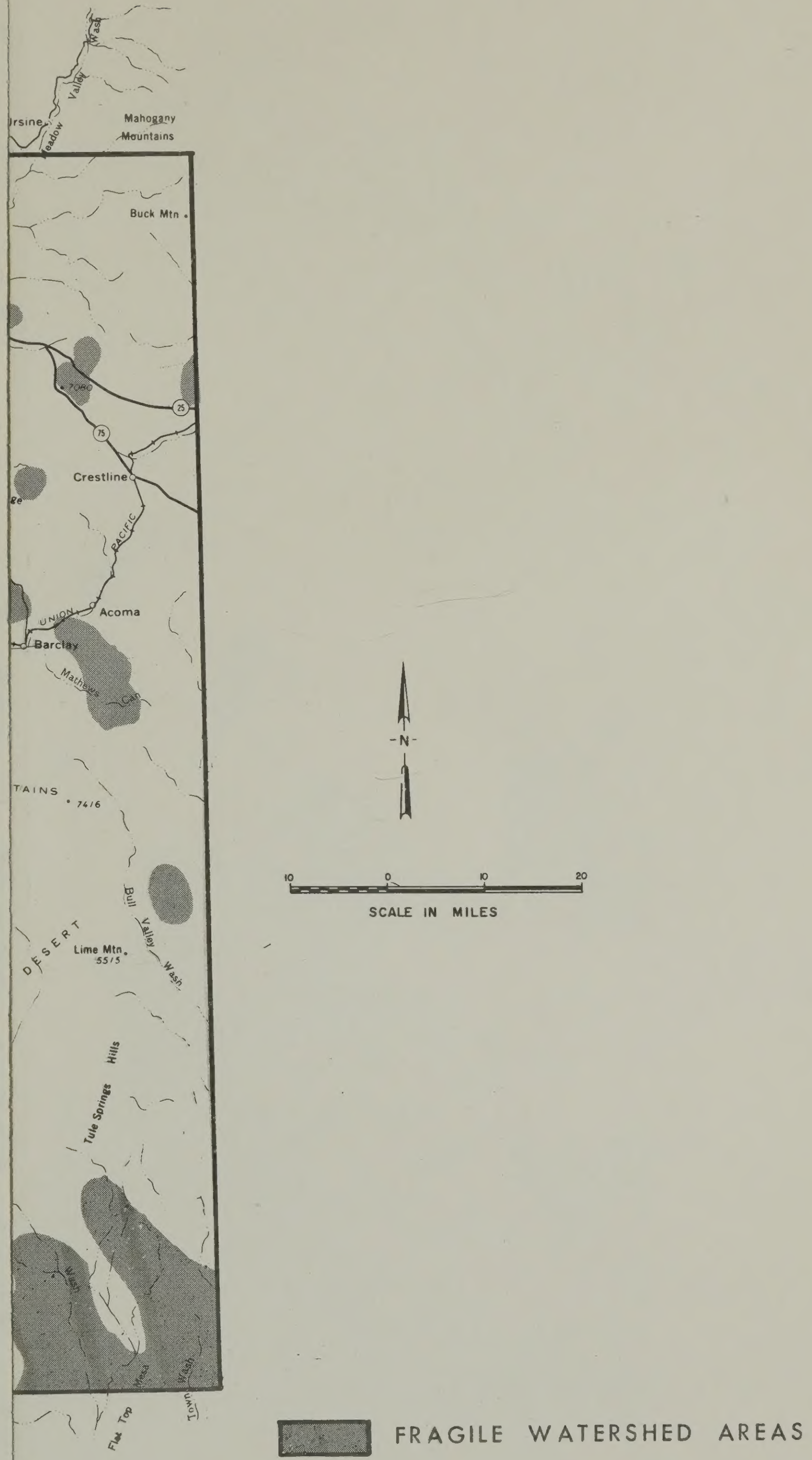


FRAGILE WATERSHED AREAS REQUIRING SPECIAL PROTECTIVE MANAGEMENT

WATERSHEDS REQUIRING SMALL DAMS AND EROSION CONTROL STRUCTURES

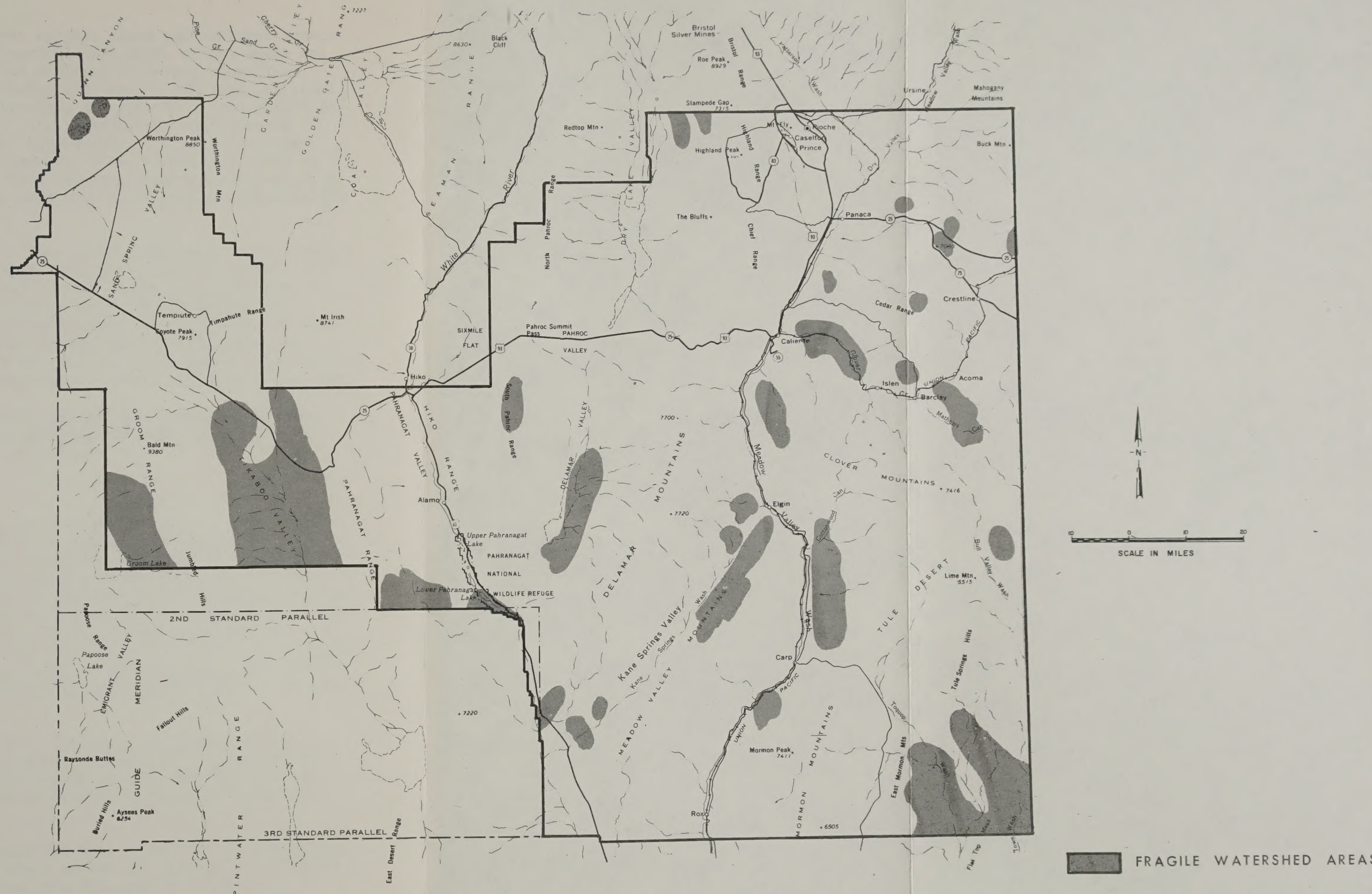
WATERSHED RESOURCE
Virgin Valley Planning Unit

MAP #6



WATERSHED
Caliente Planning Unit

MAP #7



WATERSHED
Caliente Planning Unit
MAP #7

In Lower Virgin River Valley, flood and sediment damage has caused loss of agricultural land, crops, roads and highways. Damage has occurred to homes, waterlines, irrigation water intakes and canals, and farm equipment. Sedimentation and breaking of canal walls may result in severe crop losses. The source areas contribution appears to come from highly erosive, low productive capacity National Resource Lands. Floods of small to moderate intensity have occurred almost every year with large damage producing storms occurring at approximately ten year intervals.

There are two major flood plain areas in Lincoln County: the Meadow Valley Wash through Panaca and Caliente and the Pahranagat Valley through Alamo and Ash Springs. The Preliminary Lincoln County Master Plan (1974) recommends construction of numerous small retainer dams along all tributaries to the Meadow Valley Wash area coupled with a plan to seed and plant many of the erosion-prone areas to reduce the potential of downstream floods.

Most of the Pahranagat Valley is a large, relatively flat flood plain of stable soils where heavy erosion and runoff are not prevalent.

c. Minerals

In the 1860's, the discoveries of valuable minerals led to the settlement of most of the communities present in the Caliente Planning Unit: Pioche (copper, lead, silver, gold, zinc), Panaca (stone products), Delamar (gold) and Tempiute (silver and, more recently, tungsten). Recently lead, zinc and silver mines have been reopened in Pioche, and the reopening of the tungsten mines at Tempiute is imminent. Small quantities of gold, silver, zinc, lead, copper, uranium, tungsten, mica, vermiculite, veryl, feldspar and thorium have been found in the Gold Butte area.

The Meadow Valley area (Caliente and Virgin Valley Planning Units) has potential for oil and gas development though no producing wells have yet been drilled. Texaco has explored in Meadow Valley Area in T. 12 S., R. 65 E..

The area around Moapa has been identified as a potential geothermal site. Areas around Ash Springs and Caliente Hot Springs may also have some geothermal value.

In Lower Virgin River Valley, flood and sediment damage has caused loss of agricultural land, crops, roads and highways. Damage has occurred to homes, waterlines, irrigation water intakes and canals, and farm equipment. Sedimentation and breaking of canal walls may result in severe crop losses. The greatest sediment contribution appears to come from highly erosive, low productive National Resource Lands. Floods of small to moderate intensity have occurred almost every year with large damage producing storms occurring at approximately ten year intervals.

There are two major flood plain areas in Lincoln County: the Meadow Valley Wash through Panaca and Caliente and the Pahranagat Valley through Alamo and Ash Springs. The Preliminary Lincoln County Master Plan (1974) recommends construction of numerous small retention dams along all tributaries to the Meadow Valley Wash area coupled with a plan to zone and place many of the structure areas to reduce the potential of disastrous floods.

Most of the Pahranagat Valley is a larger relatively flat flood plain of stable soils where heavy erosion and runoff are not prevalent.

c. Minerals

In the 1860's, the discoveries of valuable minerals led to the settlement of most of the communities located in the Caliente Planning Unit: Pioche (copper, lead, silver, gold, zinc), Panaca (stone products), Delamar (gold) and Tempiute (silver and, more recently, tungsten). Recently lead, zinc and silver mines have been reopened in Pioche, and the reopening of the tungsten mines at Tempiute is imminent. Small quantities of gold, silver, zinc, lead, copper, uranium, tungsten, mica, vermiculite, beryl, [illegible] and [illegible] have been found in the Gold Butte area.

The Meadow Valley area (Caliente and Virgin Valley Planning Units) has potential for oil and gas development although no producing wells have yet been drilled. Traces were reported in Meadow Valley Wash in T. 13 S., R. 65 E.

The area around Moapa has been identified as a potential geothermal site. Areas around Ash Springs and Caliente Hot Springs may also have some geothermal value.

d. Land Uses

The overwhelming majority of the land in the Caliente and Virgin Valley Planning Units is managed by the Federal government. The breakdown of land ownership is as follows:

	Virgin Valley	Caliente
BLM	1,256,719 ac	3,416,106 ac.
National Park Service	292,070 ac.	0
Bureau of Reclamation	23,736 ac.	0
Bureau of Indian Affairs	999 ac.	0
Fish & Wildlife Service	1,514,858 ac.	1,311 ac.
State	249,790 ac.	4,105 ac.
County	50 ac.	1,000 ac.
Private	22,600 ac.	59,045 ac.

Major highways include Interstate 15, U.S. Highway 93, and State Routes 7, 12, 25, 40, 54, 85, and 86.

Recreation, (hunting, fishing, picnicking, sight-seeing, etc.) agriculture and mining seem to be the major land uses in the Caliente and Virgin Valley Planning Units.

State Parks, like Beaver Dam (2,032 acres), Cathedral Gorge (1,608 acres), Echo Canyon Dam (680 acres), Kershaw Ryan (240 acres) and Valley of Fire (26,000 acres), and the Federal Lake Mead National Recreation Area provide opportunities for hiking, picnicking, camping, sight-seeing, etc. The Overton Wildlife Management Area, the Pahranagat National Wildlife Refuge and BLM lands provide hunting and fishing opportunitites.

The Nevada State Park System has identified Arrow Canyon, Buffington Pockets, Virgin Mountain, Whitney Pockets and Bitter Ridge as having values suited for inclusion within their park system.

Additionally, the Nevada Statewide Comprehensive Outdoor Recreation Plan (SCORP) has identified the following areas on National Resource Lands within the Caliente and Virgin Valley Planning Units on its list of recreational properties to be acquired for recreational development: (1) Gleason Canyon/Panaca Charcoal Kilns, (2) areas adjacent to the Valley of Fire State Park, (3) areas adjacent to the Beaver Dam State Park, (4) a tract on Highland Peak, (5) an area in the Virgin Mountains, (6) a tract in Rainbow Canyon, (7) a tract in Muddy Mountains, (8) the Worthington Mountains, and (9) a tract in the Delamar Mountains.

The Planning Units are divided into many allotments (see Livestock section) which are used for livestock grazing. Some crops are grown on private irrigated fields throughout the study area.

e. Land Use Planning

The Unit Resource Analysis (URA) and Management Framework Plans (MFP) have been completed for both the Caliente and Virgin Valley Planning Units. The MFP decisions which specifically affect the discussion in the E.A.R., are listed in the Appendix.

3. Water

a. Surface and Ground Water

Surface water is more prevalent in the Virgin Valley and Caliente Planning Units than it is in most other areas of the Las Vegas District. There are two rivers here - the Muddy River and the Virgin River - with mean annual discharges of 33,600 acre feet and 162,000 acre feet respectively. The Muddy River has a maximum flow in January and February and a minimum flow in June and July. Meanwhile, the Virgin River has a maximum flow in April and May and a minimum flow in June and July.

Lake Mead, a large man-made lake created in the 1930's, covers 164,000 acres and has a capacity of 29,680,000 acre feet. Much smaller natural lakes include Hiko, Frenchy, Upper Pahranagat and Lower Pahranagat Lakes. The water levels in these lakes vary both seasonally and from year to year. Two reservoirs - Bowman (4000 acre-foot capacity used for irrigation) and Honey Bee Pond (100 acre-foot capacity used for recreation) are also present in the study area. Still other water sources include Nesbitt, Schroeder and Echo Canyon Reservoirs.

Of special interest and importance are the thermal springs scattered throughout the area because not only are they sanctuaries for protected, endemic fish (see Wildlife section), but they are indicative of areas with potential for geothermal development. The largest thermal springs (which are fed by warm underground water sources), are Rogers, Warm, Crystal, Caliente, Ash and Hiko Springs.

Large amounts of water are available from sub-surface reservoirs. Approximately 120,000 acre-feet are in storage in the Virgin Valley Planning Unit alone. At some sites like Pahranagat Valley, this water is very near the surface; in other areas, like Coal and Pahroc Valleys, the water table is over 200 feet deep. Some of this underground supply is pumped for irrigation, domestic and stock use.

The Planning Units are divided into many allotments (see Livestock section) which are used for livestock grazing. Some crops are grown on private irrigated fields throughout the study area.

e. Land Use Planning

The Unit Resource Analysis (URA) and Management Framework Plans (MFP) have been completed for both the Caliente and Virgin Valley Planning Units. The MFP decisions which specifically affect the discussion in the E.A.R., are listed in the Appendix.

3. Water

a. Surface and Ground Water

Surface water is more abundant in the Virgin Valley and Caliente Planning Units than it is in most other areas of the Las Vegas District. There are two rivers here - the Muddy River and the Virgin River - with mean annual discharges of 33,500 acre feet and 167,000 acre feet respectively. The Muddy River has a maximum flow in January and February and a minimum flow in June and July. Meanwhile, the Virgin River has a maximum flow in April and May and a minimum flow in June and July.

Lake Mead, a large man-made lake created in the 1930's, covers 162,000 acres and has a capacity of 29,500,000 acre feet. Much smaller natural lakes include Eagle, Kenedy, Upper Pahranagat and Lower Pahranagat Lakes. The water levels in these lakes vary both seasonally and from year to year. Two reservoirs - Sunnyside (1,400 acre-foot capacity used for irrigation) and Ruby Lee Lake (100 acre-foot capacity used for recreation) are also present in the study area. Small other water sources include Nesbitt, Schroeder and Echo Canyon Reservoirs.

Of special interest and importance are the thermal springs scattered throughout the area because not only are they candidates for unique fish, endemic fish (see Wildlife section), but they are indicators of areas with potential for geothermal development. The largest thermal springs (which are fed by warm underground water sources), are Rogers, Moapa, Crystal, Hiko, Ash and Ely Springs.

Large amounts of water are available from sub-surface reservoirs. Approximately 170,000 acre-feet are in storage in the Virgin Valley Planning Unit alone. At some sites like Pahranagat Valley, this water is very near the surface; in other areas, like Coal and Garden Valleys, the water table is over 200 feet deep. Some of this underground supply is pumped for irrigation, domestic and stock use.

b. Water Quality

The rock and soil through which water percolates and flows in southern Nevada contains calcium, magnesium, carbonates, silicates, sulfides, borates, sulfates, and halides. The quality of water throughout the study area reflects this. Most of the water contains large amounts of dissolved solids (primarily halite and sulfates). The recommended maximum concentration of dissolved solids for domestic use is 500 milligrams per liter (mg/l). Excessive concentrations of dissolved solids are present in the Virgin River (1000-3000 mg/l), Muddy River (700 mg/l) and the Virgin River flood plains (1000-5000 mg/l). Relatively low concentrations are found in the Bunkerville-Mesquite area (300-500 mg/l) and Hiko, Crystal and Ash Springs Areas.

The high salinity of waters in the Muddy and Virgin Rivers can be seen by driving past some of the irrigated fields in the area; they are crusted with salts. The two rivers themselves also carry large amounts of silt and are quite muddy.

The Virgin River also contains large amounts of sulfate (450 mg/l) while the recommended maximum concentration is 250). The Black Mountains, California Wash and Lower Moapa Valley contain waters with concentrations of sulfate greater than 1600 mg/l.

Other isolated water quality problems include the Black Mountains whose water contains more than 1190 mg/l (recommended Maximum concentration is 250 mg/l) of chloride,and 1.5 to 3.3 mg/l of fluoride (recommended maximum concentration varies from 1.4ppm at 80-91oF to 2.4ppm at 50-54oF.) and springs near the Muddy River which contain 2.0-2.5 mg/l of fluoride.

4. Hazards

Flooding, discussed under "Soils", is the major hazard in the study area. Flood-prone areas include the Virgin and Muddy River lowlands, the Pahranagat Valley flood plain and the Meadow Valley Wash. Other areas along washes throughout the two planning units suffer from flash floods during and after intense storms in July and August.

There is one natural geologic hazard. Devil's Throat is a deep sink hole (recently fenced by BLM) in the Virgin Valley Planning Unit. Sand and dust storms are other natural hazards.

b. Water Quality

The rock and soil through which water percolates and flows in southern Nevada contains calcium, magnesium, carbonates, bicarbonate, sulphides, borates, sulfates, and chlorides. The quality of water in streams and wells also reflects this. Most of the water contains large amounts of dissolved solids (primarily sulfate and chlorides). The recommended maximum concentration of dissolved solids for domestic use is 500 milligrams per liter (mg/l). Excessive concentrations of dissolved solids were present in the Virgin River above Littlefield, Muddy River (1200 mg/l) and the Virgin River flood plain (1100-5000 mg/l). Selectively the concentrations are found in the Bunkerville Mesquite area (2300-3000 mg/l) and Moapa, Glendale and Logandale areas.

The high salinity of waters in the Muddy and Virgin Rivers can be seen by drilling into some of the irrigated fields in the area. They are crusted with salts. The two rivers, themselves also carry large amounts of silt and are quite muddy.

The Virgin River also contains large amounts of sulfate (1250 mg/l) while the recommended maximum concentration is 250. The Riverside, Bunkerville, Mesquite Wash and Lower Moapa Valley contain waters with concentrations of sulfate greater than 1200 mg/l.

Other isolated water quality problems include the Mormon Mountains where waters contains more than 250 mg/l (recommended maximum concentration is 250 mg/l) of chloride and 1.5 to 3.4 mg/l of fluoride (recommended maximum concentration varies from 1 ppm at 80-90°F to 2 ppm at 50-54°F); and springs near the Muddy River which contain 1.0-2.2 mg/l of fluoride.

c. Hazards

Flooding, discussed under "Soils", is the major hazard in the study area. Flood-prone areas include the Virgin and Muddy River bottoms, the floodplain of Toquop Wash, and the Meadow Valley Wash. Flash flood areas occur throughout the two planning units during flash floods during and after intense storms in July and August.

There is one natural geologic hazard. Devil's Throat is a deep sink hole presently fenced by BLM in the Virgin Valley Planning Unit. Sand and dust storms are other natural hazards.

Other, man-made hazards, include those associated with mining operations (abandoned tunnels, heavy equipment, etc.) and sewage ponds (Mesquite, Overton).

See Maps #8 and 9 for locations of these hazards.

B. Living Components

1. Vegetation

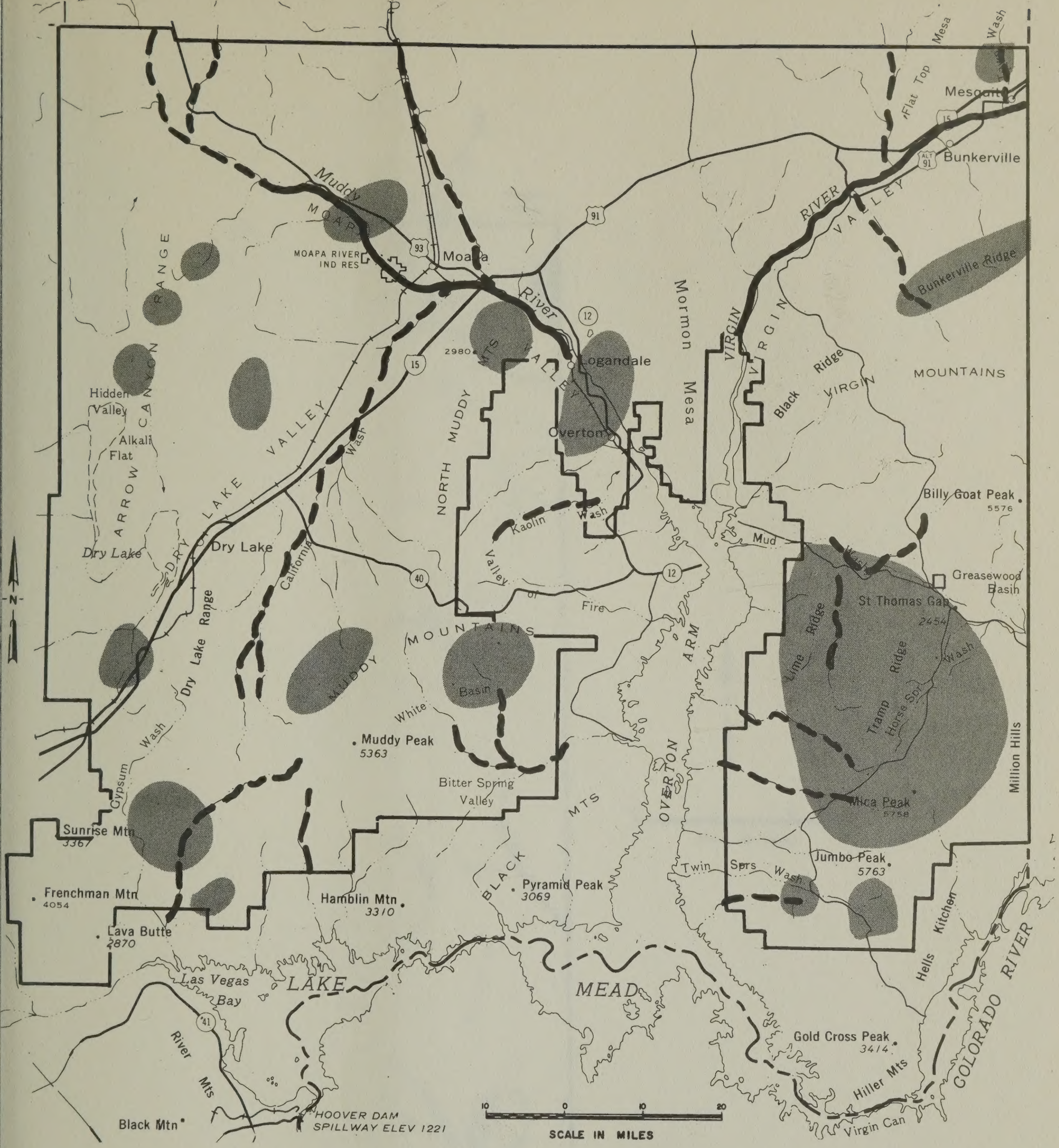
The scant precipitation in the study area limits the variety and number of plants that can survive here. All the plants that grow in the area have special adaptations that allow them to do so. Some plant species escape harsh desert weather by developing and blossoming rapidly during summer or mid-winter showers and allowing their mature seeds to lie dormant during hot, dry seasons. Other species have leaves with little surface area (to reduce transpiration), extensive root systems (to soak up maximum amount of percolating waters), tissues which store water or protective coverings of "hair" or wax.

The study area is covered by two major zones of vegetation - The Great Basin Desert (also known as the Sagebrush-Pinyon-Juniper Belt of Upper Sonoran Zone) and the Mohave Desert. The Mohave Desert covers most of the Virgin Valley Planning Unit while the Caliente Unit falls into the Great Basin Desert.

The vegetation of the Mohave Desert includes over 300 species of plants. Grasses which grow in the area are rough tobosa (Hilaria rigida), desert needle-and-thread (Stipa arida), Indian ricegrass (Oryzopsis hymenoides), black grama (Bouteloua eriopoda), Sideoats grama (B. curtipendula), tobosa (Hilaria mutica), galleta (Hilaria jamesii), 3-awn (Aristida glauca), fluff (Tridens muticus), eyelash (Blepharidachne kingii), and Thurber's needle-and-thread (Stipa thurberiana).

Forbs are seldom found except in very wet years. The most notable grazing forbs include alfilaree (Erodium cicutarium), Indian wheat (Plantago insularis), and desert hollyhock (Sphaeralcea ambigua).

Browse plants dominate the vegetation of the area and account for well over 95% of the vegetation. These include creosote bush (Larrea divericata), Joshua tree (Yucca brevifolius), Spanish dagger (Yucca schidigera), juniper (Juniperus osteospermus), pinyon pine (Pinus monophylla),



PERENNIAL STREAMS PRONE TO FLOODING

WASHES SUBJECT TO FLASH FLOODING

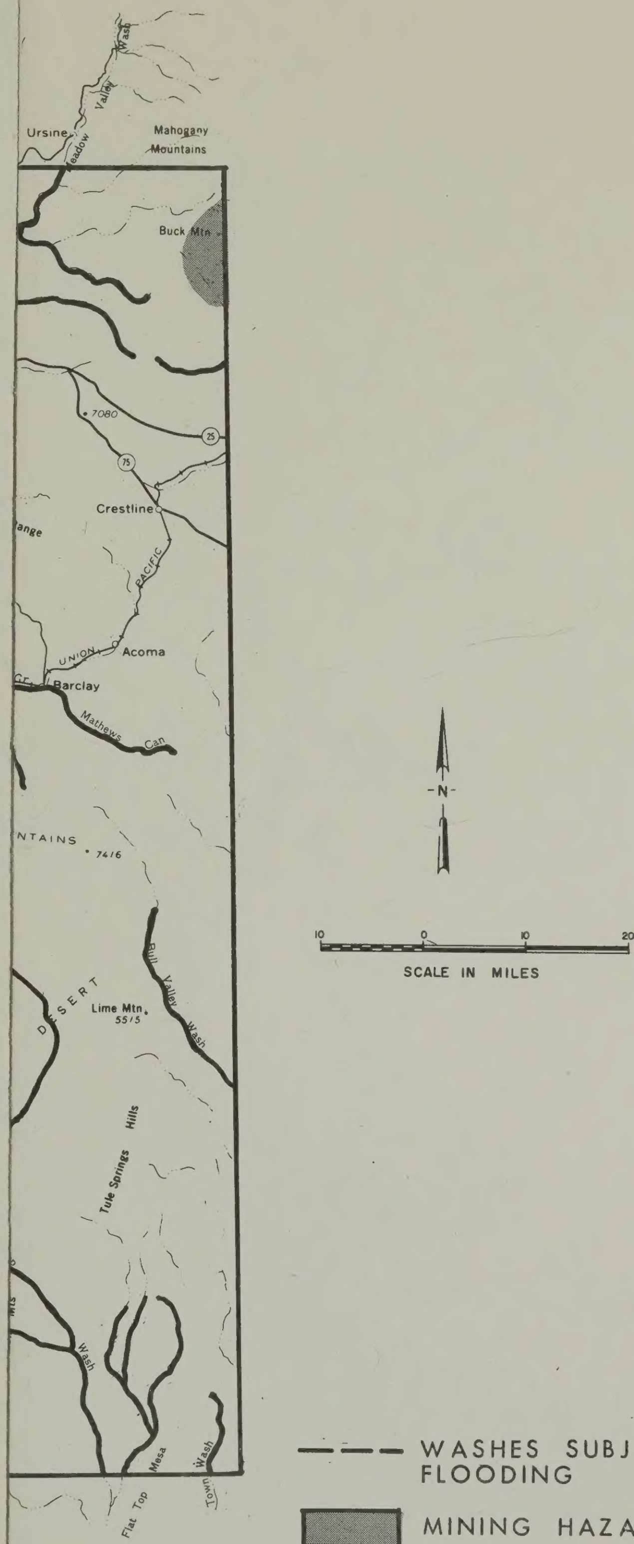
MINING HAZARD AREAS

GEOLOGIC HAZARDS

PHYSICAL HAZARDS

Virgin Valley Planning Unit

MAP #8

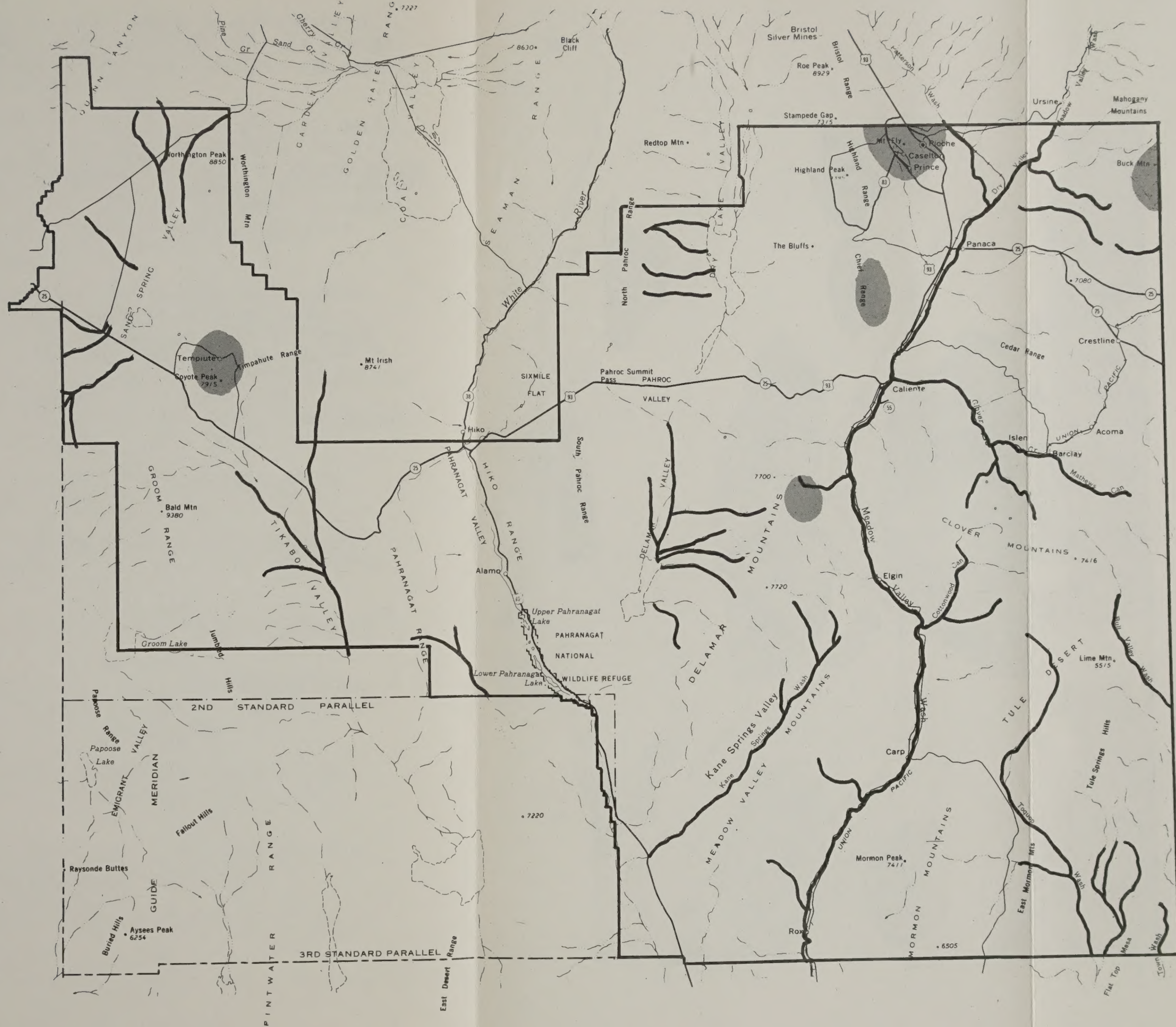


WASHES SUBJECT TO FLASH FLOODING

MINING HAZARD AREAS

PHYSICAL HAZARDS
Caliente Planning Unit

MAP #9



— — — WASHES SUBJECT TO FLASH FLOODING

MINING HAZARD AREAS

PHYSICAL HAZARDS
Caliente Planning Unit

MAP #9

3 wolfberries (Lycium spp.), desert peach (Prunus andersonii), desert almond (Prunus fasiculata), winterfat (Eurotia lanata), burr-sage (Franseria dumosa), blackbrush (Coleognye ramosissma), sagebrush (Artemisia spp.), and others.

Browse plants also dominate the vegetation of the Great Basin Desert. Instead of creosote bush and Joshua trees, however, big sagebrush (Artemisia tridentata), rabbitbrush (Chrysothamnus vicidiflorus), shadscale and saltbush (Atriplex) and greasewood (Sarcobatus vermiculatus) are prevalent. At higher elevations, pinyon pine, juniper, mountain mahogany (Cercocarpus) and Gambel's oak (Quercus gambelli) occur.

In the study area, there are several interesting, isolated stands of vegetation. White fir (Abies concolor) covers a few thousand acres in the Virgin, Highland Peak, Pahranagat and North and South Pahroc Ranges. Ponderosa pine occurs in the Clover Mountains and on Highland Peak. At extreme elevations in the Highland Peak Range, bristlecone pines (considereed the oldest living tress) are found. Washingtonia Palms (though to be native) occur at Warm Springs.

Maps 10 and 11 display the major vegetation types in the Caliente and Virgin Valley Planning Units:

Creosote - large type containing creosote bush, burrsage, Mormon tea, white sage and other vegetation with plant density only about 3-5%.

Desert shrub - includes Spanish dagger, burrsage, blackbrush and others.

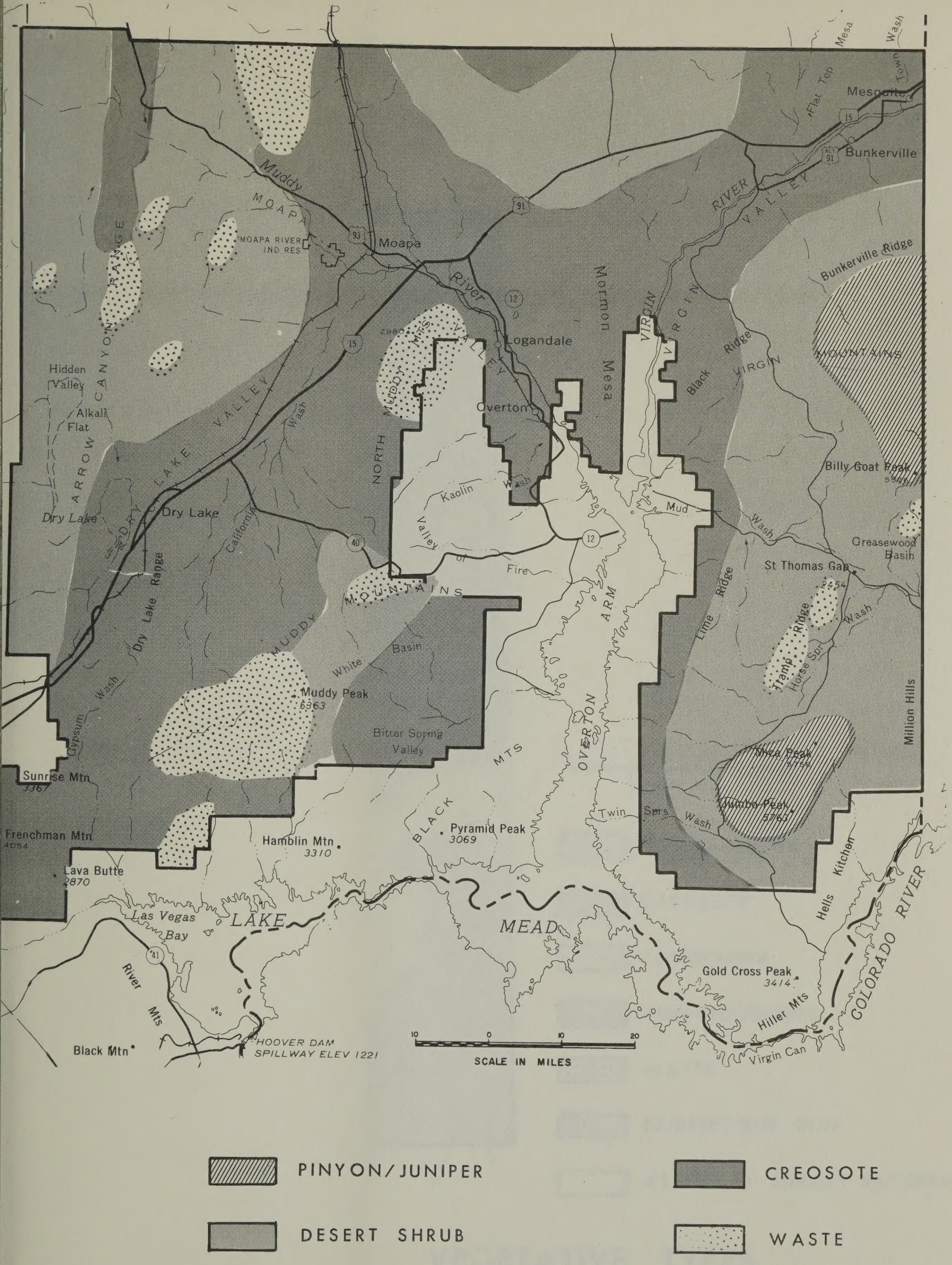
Pinyon/Juniper - composition is usually 40% or more pinyon and juniper trees with some blackbrush, sagebrush, Mormon tea, Indian ricegrass and others.

Waste - primarily dry lakes or steep rocky slope but may contain some pockets of grasses like desert needle-and-thread.

Assorted shrubs - Great Basin - type shrubs (big sagebrush, rabbitbrush, salt bush, etc.).

Bristlecone pine - isolated stands of these very old and unique trees.

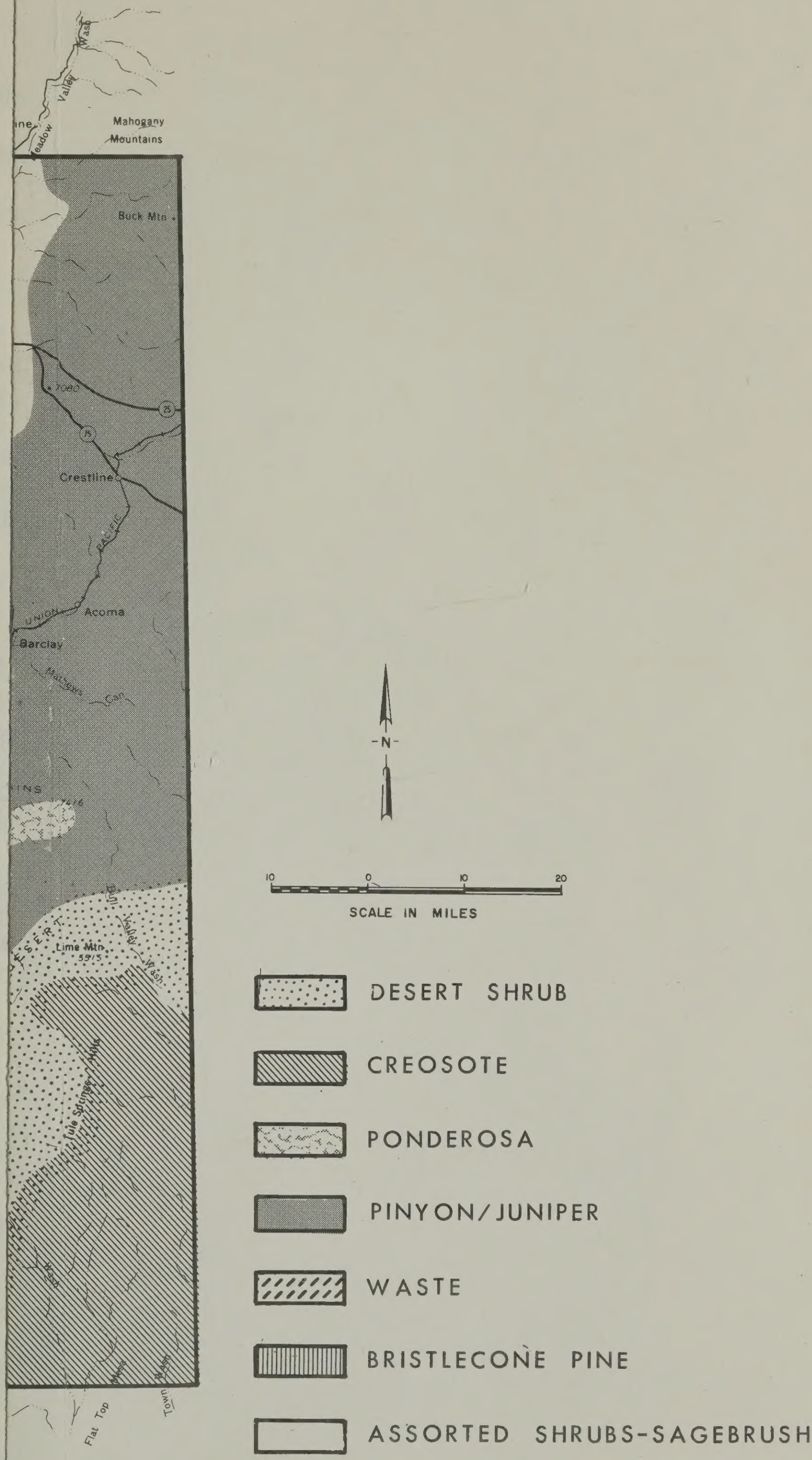
Ponderosa - high elevations with ponderosa and white fir.



VEGETATIVE TYPES

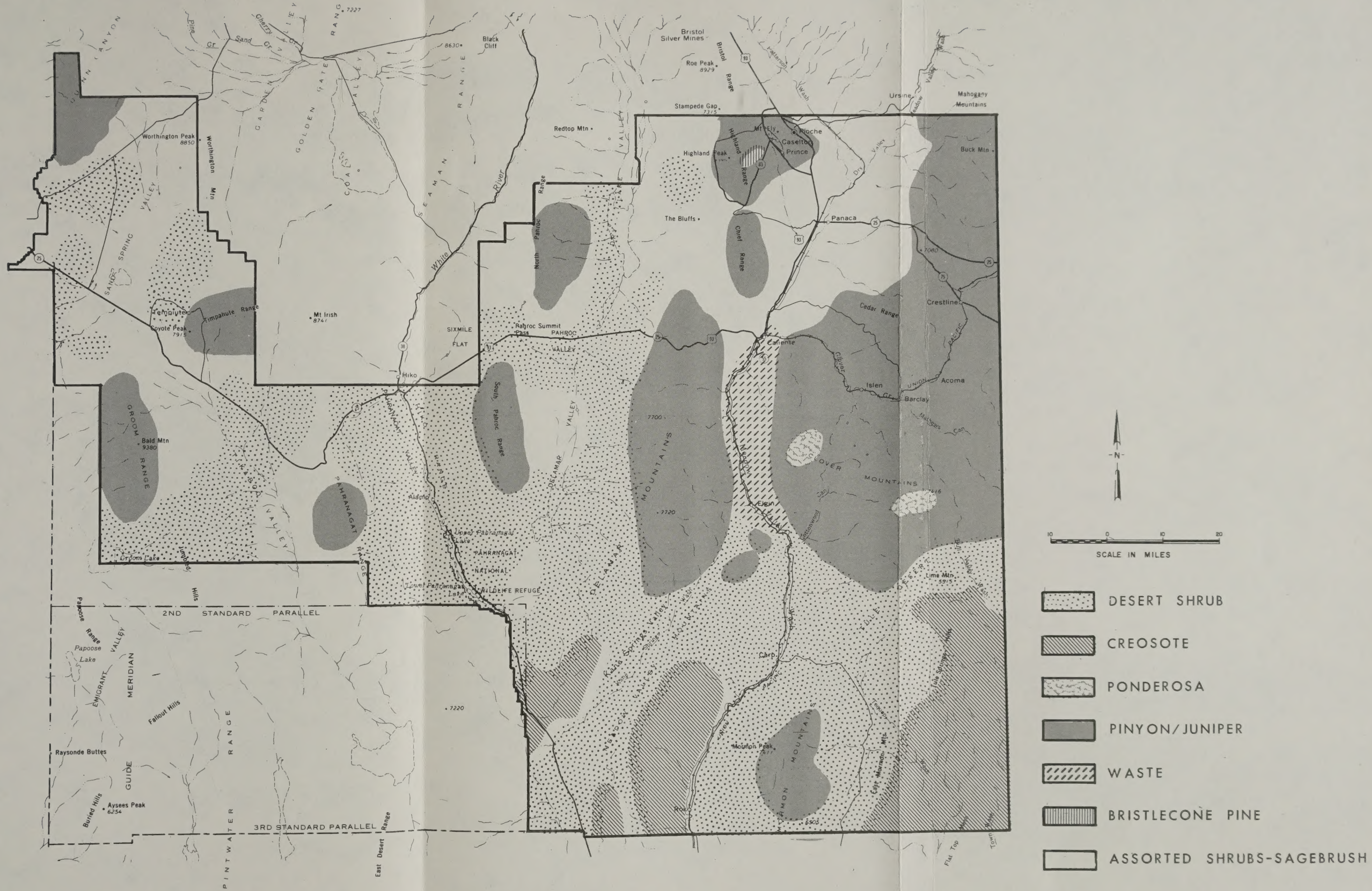
Virgin Valley Planning Unit

MAP #10



VEGETATIVE TYPES
Caliente Planning Unit

MAP #11



VEGETATIVE TYPES
Caliente Planning Unit
MAP #11

There are few, if any, poisonous plant problems within the study area. In moist years, death camas (*Zigadenus*), locos (*Astragalus*) and desert plume (*Stanleya pinnata*) may occur.

During moist years, washes and lowlands are sometimes ablaze with primroses, poppies, sunflowers, blossoming globemallows and cacti and other beautiful desert flowers.

2. Wildlife

Many species of mammals, birds, reptiles, amphibians and fish inhabit the Caliente and Virgin Valley Planning Units (see Wildlife lists in the Appendix). Only two Habitat Management Plans - the Beaver Dam HMP (revised by the Las Vegas District Office in 1975), and the Horsethief - Dry Valley HMP (written by the Ely District Office in 1974) - have been completed in the study area.

The big game animals present include mule deer, antelope, bighorn sheep, and mountain lions.

Small deer herds are present on Mica, Jumbo and Virgin Peaks, while larger herds are present in the Clover, Meadow Valley, Mormon, North and South Pahroc, Pahranagat, Bold, Quinn, Highland and Irish mountain ranges. So far crucial areas* (covering a little over 51,000 acres) have been identified in the Clover Mtns., Cedar Range and Dry Valley. Lack of good summer habitat (with permanent, plentiful water supplies and succulent forage) is one factor greatly limiting the numbers and distribution of deer in the study area. Only the highest elevations of Highland Peak, Ella Mountain, the Worthington and Irish Mountains can be called "summer habitat". The Las Vegas District has planned to set up wildlife transects in the Caliente Planning Unit in FY 1976 which will more accurately define density and seasonal use of mule deer. Also, two water catchments have been constructed for deer in Caliente.

Over 360,000 acres of bighorn habitat have been identified in the Caliente Planning Unit and over 200,000 acres in the Virgin Valley Planning Unit. Sheep inhabit the Meadow Valley, Mormon, Pahranagat, Muddy and Arrow Canyon ranges.

Bighorn require at least one gallon of water per head per day. Lack of water thus becomes a limiting factor for sheep in these areas, particularly during dry summer months. One guzzler has been constructed in the Meadow Valley Mountains.

*"Crucial areas" are defined as areas necessary for the continuation and propagation of a wildlife population; these areas may contain an excellent supply of forage or good supplies of permanent water or necessary cover or any combination of the above.

Crucial bighorn areas have been classified in the Mormon, Muddy and Arrow Canyon Mountain Ranges. Human disturbance within these areas, especially near waters, is considered another limiting factor which hinders population growth.

An additional 145,000 acres (all in the Virgin Valley Planning Unit), have been identified as potential habitat. Historically, bighorn had been found in these mountain ranges and it is believed that they can possibly be reintroduced there in the future.

Occasionally antelope appear in the lower Lake Valley and Pioche, in Sand Spring Valley and Tikaboo Valley. These populations are presently, too, small to sustain hunting but may increase enough to allow limited hunting in the future.

A permanent population of mountain lions is scattered throughout Lincoln County. Their main prey is mule deer. Little information is available on numbers, density, habits, etc. of these animals.

Small game species in Clark and Lincoln Counties include Gambel's quail, sage grouse, cottontail rabbits, ducks, geese, chukar and doves. Chukar partridge were first introduced in the study area during the 1930's. Present populations are small, isolated and associated with steep rocky slopes close to water. Historically, large and widespread quail and sage grouse populations have been reduced to smaller, more isolated ones. Sage grouse are found only in the very northern extremes of the Caliente Unit. Quail are found in the North Pahroc, Pahranagat, Bald Mtn., and Virgin Mountain Ranges as well as the Meadow Valley Wash, Virgin and Muddy River, Gold Butte, Tule Hills and Delamar Valley areas. Small game water catchments have been constructed in the Mormon Mesa and Virgin Mountains and Gold Butte.

Waterfowl can be found at the Pahranagat Lakes, the Overton Refuge, the Virgin and Muddy Rivers and Lake Mead. Mourning doves and cottontail rabbits are distributed throughout the study area but the highest concentrations are found where quail and chukar occur. The populations of doves and rabbits fluctuate with changes in precipitation and vegetative condition.

Small huntable mammals in the study area include the gray fox, (furbearer), bobcat, coyote, badger, and striped and spotted skunk (unprotected). Beaver and muskrat (furbearers) might occasionally be found in the Meadow Valley Wash or Clover Creek. The populations of these animals fluctuate as the propulations of prey (rodents, rabbits, birds, etc.) do. Legal, licensed

Crucial bighorn areas have been identified in the Mormon, Muddy and Arrow Canyon Mountain Ranges. Human disturbance within these areas, especially near waters, is considered another limiting factor which hinders population growth.

An additional 263,000 acres, all in the Virgin Valley Planning Unit, have been identified as potential habitat. Historically, bighorn had been found in these mountain ranges and it is believed that they can possibly be reintroduced there in the future.

Occasionally antelope appear in the Pahranagat Valley and Pioche, in Sand Spring Valley and Dry Lake Valley. These populations are presently, too, small to sustain hunting but may increase enough to allow limited hunting in the future.

A permanent population of mountain lions is scattered throughout Lincoln County. Their main prey is mule deer. Little information is available on numbers, locations, family units, of these animals.

Small game species in Clark and Lincoln Counties include Gambel's quail, sage grouse, cottontail rabbits, ducks, geese, chukar and doves. Chukar partridge were first introduced in the study area during the 1950's. Present populations are small, isolated and associated with steep rocky slopes close to water. Historically, large and widespread quail and sage grouse populations have been reduced to smaller more isolated ones. Sage grouse are found only in the northern extremes of the Caliente Unit. Quail are found in the Mitch Ranges, Pahranagat, Bald Mtn., and Virgin Mountain Ranges as well as the Meadow Valley Wash, Virgin and Muddy River, Gold Butte, Bald Butte and Delamar Valley areas. Small game water catchments have been constructed in the Mormon Mesa and Virgin Mountains and Gold Butte.

Waterfowl can be found at the Pahranagat Lakes, the Overton Refuge, the Virgin and Muddy Rivers and Lake Mead. Mourning doves and cottontail rabbits are distributed throughout the study area but the highest concentrations are found where quail and chukar occur. The populations of doves and rabbits fluctuate with changes in precipitation and vegetative conditions.

Small nongame mammals in the study area include the [illegible] (furbearer), bobcat, coyote, badger, and spotted and striped skunk (unprotected). Beaver and muskrat (furbearers) which occasionally be found in the Meadow Valley Wash or Virgin River. The populations of these animals fluctuate as the populations of prey (rodents, rabbits, birds, etc.) do. Legal furbearer

harvest of furbearers is small in Lincoln County (less than 800 animals were taken in the 1973-74 season) and practically non-existent in Clark County. Animal control of problem predators is handled by the Fish and Wildlife Service. Predators haven't been as much of a "problem" here as they have been in other districts. Coyotes and lions are the major targets. In 1974, the Las Vegas Advisory Board authorized $4,000 for predator control.

Game fish are found in Beaver Dam, Clover and Pine Creeks, Pahranagat Lakes, Lake Mead, and Virgin and Muddy Rivers. Some of the species available to fishermen are rainbow, and brook trout, black bullhead and channel catfish, bluegill sunfish, black crappies and largemouth and striped bass. Nongame fish include mountain and humpback suckers, mosquito fish, Lahotan cutthroat trout, fathead minnows, redshiners, speckled dace, carp and exotic tropical fish (guppies, mollies, goldfish, etc.).

Of special importance in the two planning units are those species with endangered or protected status. Those that may be found in either the Caliente or Virgin Valley Planning Units include:

Species	Status
Spotted bat (Euderma maculata)	Endangered - State of Nevada
Gila Monster (Heloderma suspectum)	Rare - State
Desert tortoise (Gopherus agassizi)	Rare - State
Peregrine falcon (Falco peregrinus)	Endangered, State,Federal
Southern bald eagle (Haliaeetus leucocephalus leucocephalus)	Endangered - Federal
Pahranagat bonytail (Gila robusta jordani)	Endangered - State, Federal
Moapa dace (Moapa coriacea)	Endangered - Federal Rare - State
Woundfin (Plagopherus argentissimus)	Endangered - Federal Rare - State
White River Springfish (Crenichthys baileyi)	Rare - State
Virgin River Spinedace (Lepidomeda mollispinis mollispinis)	Rare - State
Colorado River Bonytail (Gila robusta elegans)	Rare - State
Colorado River Squawfish (Ptychocheilus lucius)	Endangered - Federal, State

The spotted bat is thought to occur throughout the Southwest though little is known about its habits, distribution or habitat requirements in Nevada.

The gila monster, this country's only poisonous lizard, may possibly be found on lands along either side of Lake Mead; one was also found in the Meadow Valley Range. Little is known about this rarely seen reptile.

The desert tortoise is abundant in the Virgin Valley Planning Unit and may be found in the southern sections of the Caliente Unit. It is a herbivore that prefers the creosote bush community. Its major problems stem from: 1) destruction of habitat, especially by off-road vehicles and overgrazing, 2) death by cars and off-road vehicles 3) collection, and 4) releasing of diseased individuals back into the wild.

All species of the Orders Falconiformes (vultures, hawks, falcons) and Strigiformes (owls) are protected by State law. Some of the more important species present in the study area are the peregrine falcon (possible nesting sites in the Virgin Mountains), prairie falcon (more widespread, in most of the mountain ranges), the bald eagle (winters around Lake Mead) and the golden eagle (scattered throughout Caliente Planning Unit, large numbers are present in Delamar Valley). More study is needed to delineate specific nesting areas that need protection.

The Pahranagat spinedace and White River mountain sucker are two species which have become extinct in the area, due to irrigation development and competition with exotic fish. There are many other species still present whose habitat requires protection.

The Virgin River provides habitat for the Virgin River spinedace and the woundfin. The woundfin is found in small numbers only near the Utah border and prefers shallow, turbid waters. The spinedace is more common in the River.

The Muddy River provides habitat for the Moapa dace, a small fish whose numbers are rapidly declining. It is also found at Warm Springs. But channelling and development on private lands (see postcard) is threatening its continued existence there.

The White River springfish is found in Crystal, Warm and Ash Spring. It faces the same threats as the dace does at Warm Springs. It shares its Ash Springs habitat with mollies, cichlids, and other tropical fish as well as many summer recreationists. But its population there is stable at a low level and should remain so as long as the habitat is not further altered.

DESERT OASIS WARM SPRINGS RESORT

Less than one hour from Las Vegas in the beautiful Moapa Valley. A true OASIS featuring 90° pure, warm, spring water swimming, golf, horseback riding, shuffle-board and other games. Immaculate camping facilities. Group functions. Write P.O. Box 41, Moapa, Nev. 89025. Phone 702 - 865-2780.

"A Mother Nature Creation" . . .
. . . with a little help of some friends.

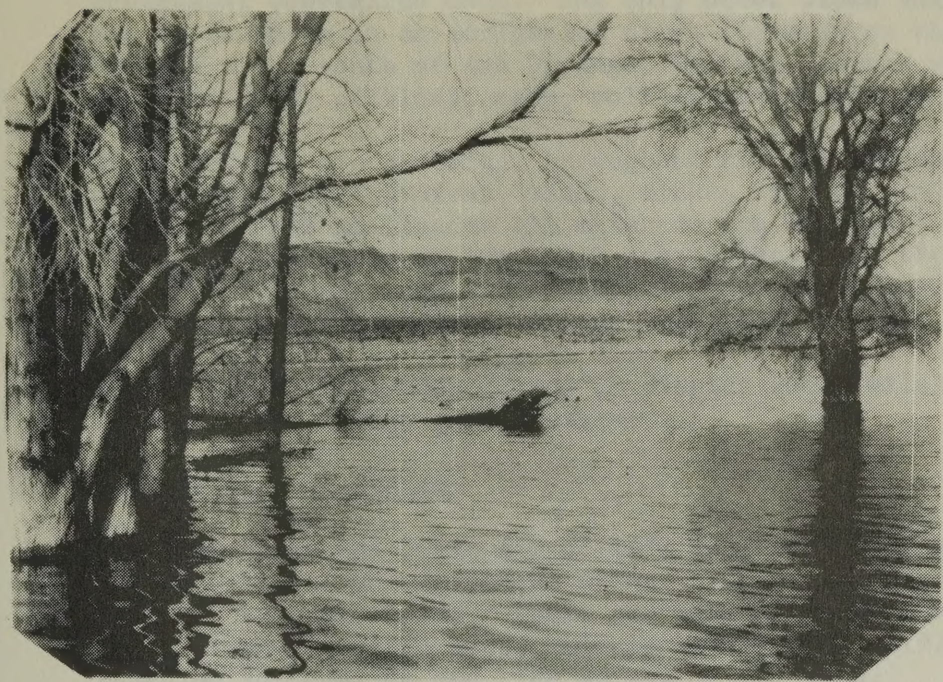
Photography Unlimited, Las Vegas, Nevada

PLACE
STAMP
HERE
R09657

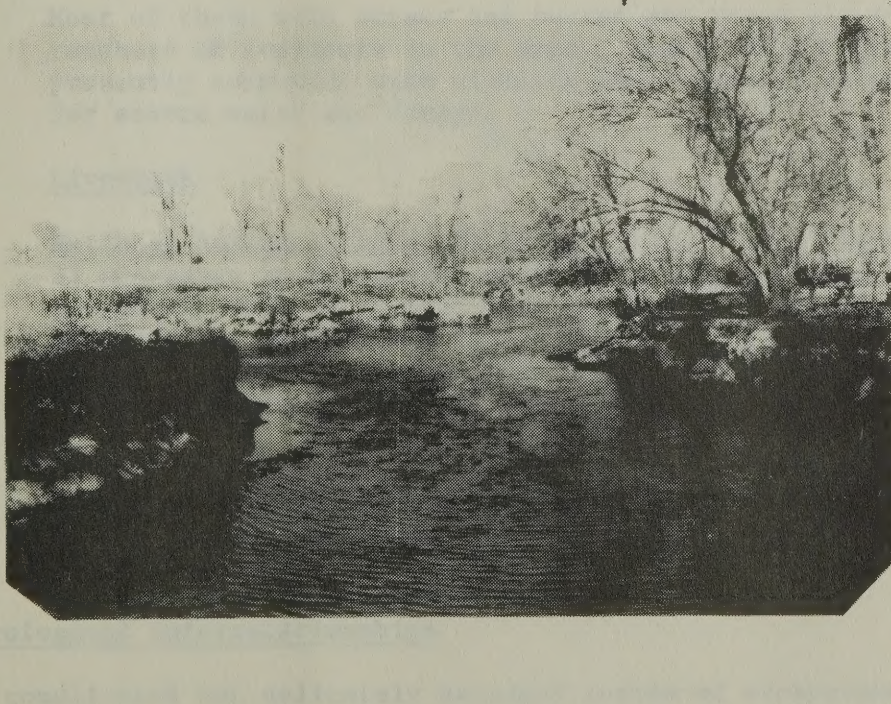
Post Card

DURANS PRESS
HOLLYWOOD FLA.

Other habitat for fish includes...



Pahranagat Lake (at high stage) and



Ash Spring

Finally, Crystal Spring is the type locality of the Pahranagat bonytailed chub. The only other place this species may be found is in an irrigation ditch (located on the Burns Ranch 2 miles south of Ash Springs) which it shares with speckled dace, cichlids, carp, mollies and mosquito fish.

Invertebrates are prevalent throughout the two planning units; insects, scorpions, mites, ticks, isopods, spiders, centipedes and millipedes all exist in the southwest deserts. Of particular interest are small crestaceans like the tadpole shrimp whose eggs lie dormant in ephemeral lakes and ponds until a sudden storm brings the areas to life.

Tables 2 and 3 and Maps 12 and 13 display known wildlife habitat distribution and acreages.

3. Wild Horses and Burros

The Wild Horse and Burro Act of 1971 made BLM responsible for the protection and management of wild horses and burros on National Resource Lands. There are many horses present in the Caliente Planning Unit; helicopter surveys in 1975 revealed between 900 and 1100 horses in the area.

Some wild burros are also present in the Caliente Planning Unit. An estimated 40 to 55 animals inhabit the Meadow Valley Wash, Kane Springs and Tule Springs areas. In the Virgin Valley Planning Unit, they are even more numerous; about 250 live in the Gold Butte area. About a dozen animals have been reported at Moapa.

Most of these wild horses and burros are traceable to former ranchers or residents in the area. These animals are presently competing with wildlife and livestock in the area for scarce water and forage.

4. Livestock

National Resource Lands are divided into 27 allotments with 35 operators in the Virgin Valley Planning Unit and into 85 allotments with 88 operators in the Caliente Unit (see Appendix for lists of operators in the study area). Most of the operators raise cattle (though several allotments are still classified as suitable for sheep).

Many range improvements and chaining/seeding projects have been initiated for livestock in the Caliente and Virgin Valley Planning units (see the two U.R.A.'s and livestock overlays).

C. Ecological Interrelationships

A complicated but delicately balanced series of ecosystems and cycles are functioning in the study area. Nutrient, water and

TABLE 2

WILDLIFE HABITAT SUMMARY
VIRGIN VALLEY RESOURCE AREA

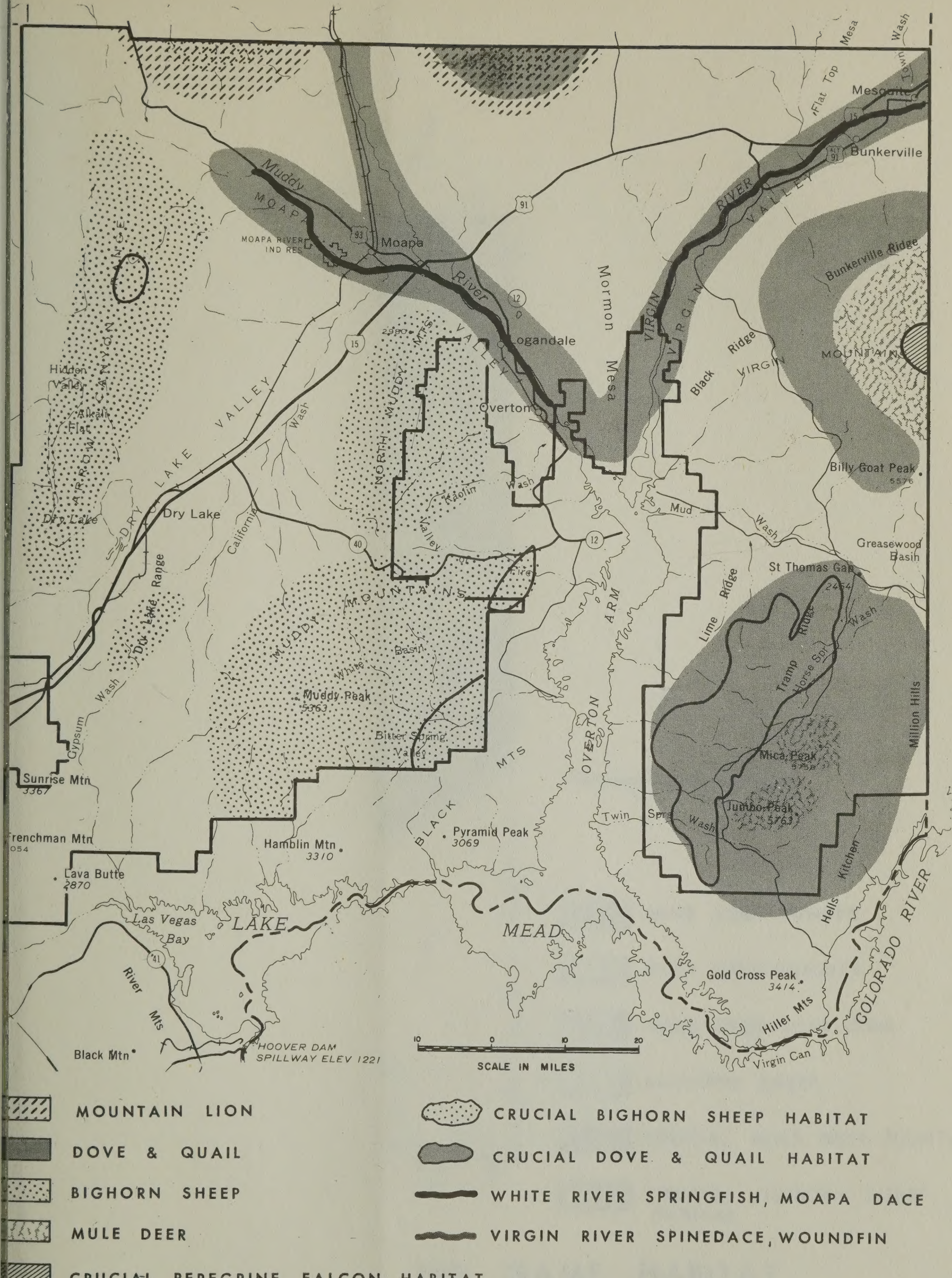
Species	Location	Yearlong Acres	Summer Acres	Winter Acres	Crucial Acres	Potential Acres	Private Acres	Federal BLM	NPS	Total Acres
Bighorn	Las Vegas Range	7,400					0	7,000	---	7,400
"	Arrow Canyon Range	55,000					120	55,000	---	55,000
"	Muddy Mtns.	78,000					800	74,000	3,200	78,000
"	Black Mtns.	54,000					0	0	54,000	54,000
"	Meadow Valley Range			4,800			0	4,800	0	4,800
"	Mormon Mtns.	1,500					0	1,500	0	1,500
"	Virgin Pk.					42,000	200	42,000		42,000
"	Tramp Ridge					17,000	0	17,000	0	17,000
"	Azure Ridge - Hells Kitchen					61,000		41,000	20,000	61,000
"	Hiller Mtns.					11,000		0	11,000	11,000
"	Bonelli Pk.					14,000		5,600	8,400	14,000
Mule Deer	Mica Pk.	3,300					0	3,300	0	3,300
" "	Jumbo Pk.	2,500					0	2,500	0	2,500
" "	Virgin Pk.	25,000					200	25,000	0	25,000
Quail	Gold Butte	108,000			29,000		200	97,000	11,000	108,000
"	Virgin Pk.	37,000					120	37,000	0	37,000
"	Virgin River	16,000					10,000	6,000		16,000
"	Muddy R. - Meadow Valley	47,000					22,000	22,000	3,000	
Tortoise	Resource Area	1,321,000					31,000	1,150,000	140,000	1,321,000
Gila Monster	(Unknown)									
Waterfowl	Virgin R.			5,120	5,120			5,120		

URA July, 1973

Table 3. Areas of BLM Lands of Vital Importance to Wildlife - Caliente Planning Unit

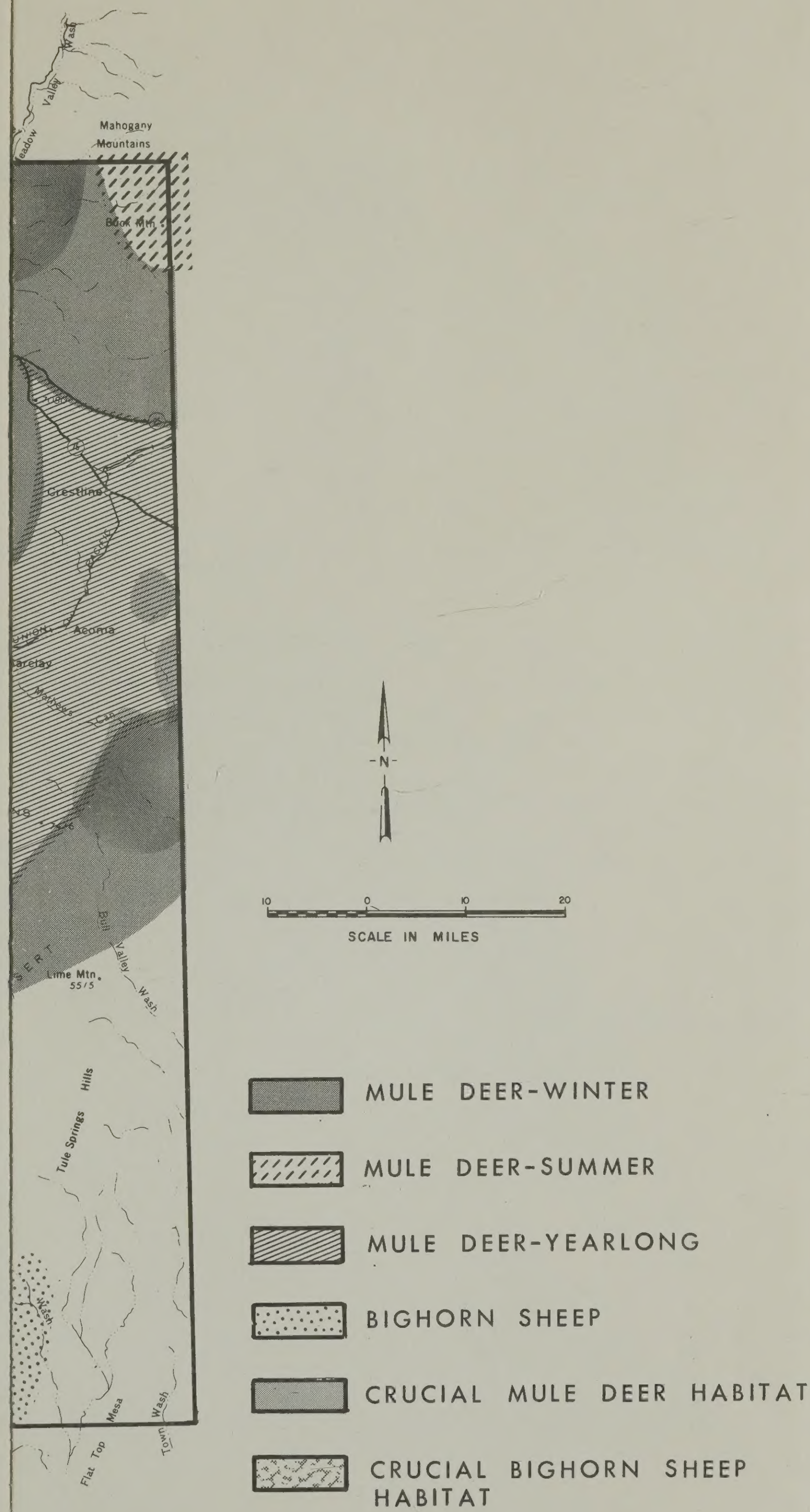
Wildlife Species	Total Acres of Habitat	Yearlong Habitat	Crucial Yearlong Habitat	Winter Habitat	Crucial Winter Habitat	Summer Habitat	Crucial Summer Habitat
Mule Deer	1,019,516	484,520	4,510	466,580	37,876	17,070	8,960
Desert Bighorn Sheep	365,885	267,515	5,040	84,800		5,390	16,080
Cottontail	3,000,000						
Gambels Quail	185,183	185,183					
Mourning Dove	35,013						
Chukar Partridge	28,445	28,445					
Water Fowl	7,160						
Tortoise	57,600						
Fish Habitat	8 miles						

May 19, 1972

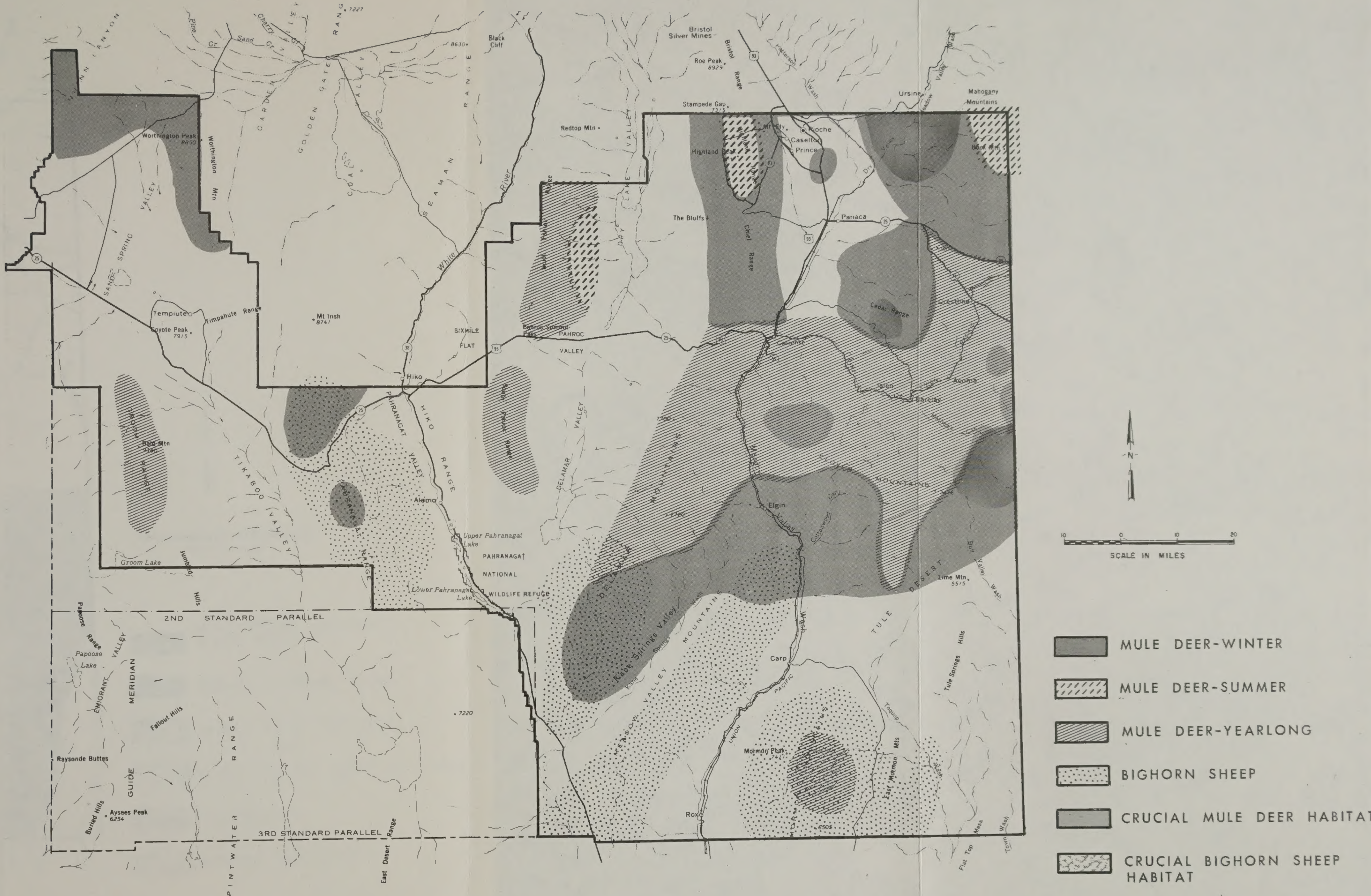


WILDLIFE HABITAT
Virgin Valley Planning Unit

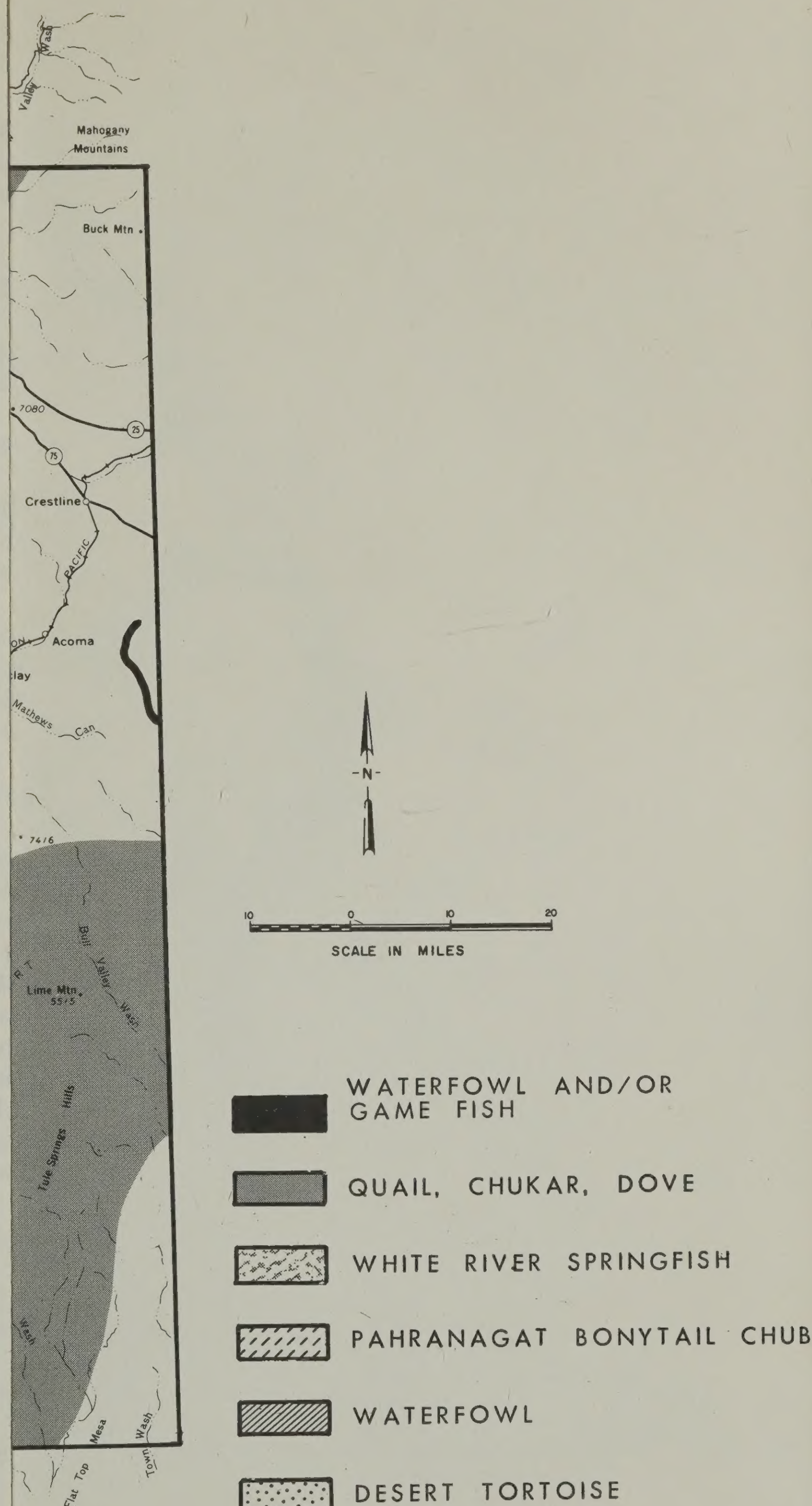
MAP #12



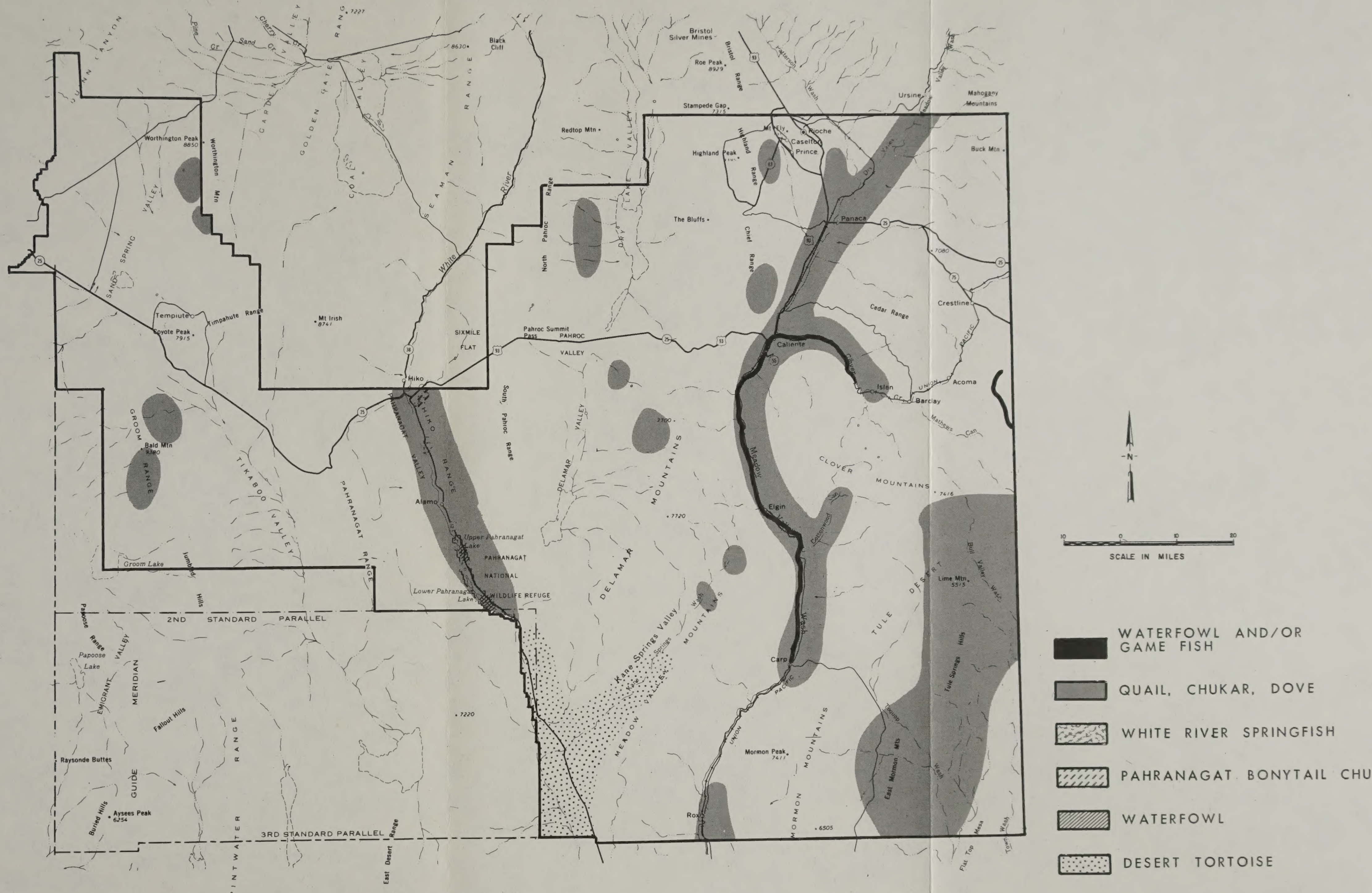
BIG GAME HABITAT
Caliente Planning Unit
MAP #13A



BIG GAME HABITAT
Caliente Planning Unit
MAP #13A



ANIMAL & FISH HABITAT
Caliente Planning Unit
MAP #13B



SMALL ANIMAL & FISH HABITAT
Caliente Planning Unit
MAP #13B

energy cycles, animal/plant, animal/animal and plant/plant interrelationships all play a part.

On land, plants like Indian ricegrass, act as primary food producers, converting sunlight, water, soil minerals and carbon dioxide into carbohydrates through photosyntheisis. These nutrients are consumed by deer, bighorn, horses, birds, tortoises and other primary consumers called herbivores. These animals, in turn, are eaten by carnivores like coyotes, bobcats and mountain lions. Omnivores like humans may eat both plants and herbivores. Finally, herbivores, carnivores and omnivores after death are the targets of scavengers, like vultures, fungi and bacteria. Plants use the nutrients created during decomposition to produce more food and the cycle begins again.

In aquatic environments like the thermal springs, the streams, and lakes, a similar cycle is occuring. Sunlight, dissolved oxygen, carbon dioxide and minerals are used by aquatic plants to photosynthesize food. Rushes, cattails, salt cedar, catclaw and other riparian vegetation around the water also produce food. Primary producers are consumed by herbivorous animals like protozoans, snails, fish and ducks. These animals, in turn, are eaten by larger fish and birds, frogs, snakes and other predators which may lurk around the waters. Scavengers, fungi and bacteria complete the cycle here as they do in terrestrial habitats.

The water cycle begins with precipitation falling to the earth. Some of it infiltrates the soil. There it is either absorbed by plant roots and becomes a part of the nutrient cycles discussed above, or it becomes part of the underground storage which feeds springs and wells. Water that doesn't enter the soil runs off rocks and desert pavement, is funnelled through rills, gullies and washes and ends up in streams like Clover Creek or Meadow Valley Wash. Water reenters the atmosphere either through transpiration from plant leaves or through evaporation from the ground, springs, streams and lakes, reaccumulating as clouds and completing the cycle.

There are many interesting cooperative relationships between different members of the ecosystem. For instance, the Yucca flower depends on pollination by the yucca moth, while the moth depends on yucca seeds to sustain its larvae. Also rodents like kangaroo rats depend on seeds for food while plants depend on the rodents to disperse their seeds. Animal/animal relationships are also intriguing. For example, some animals share burrows. It is thought that coyotes and badgers occasionally team up to hunt rodents.

Only these delicately balanced cycles and relationships can be upset by plants, wild animals, humans or climatic conditions.

Long periods of drought can send certain plants and invertebrates into dormant states. With a decrease in available forage and water, herbivores decrease in number and their range shrinks to small areas of good food, near permanent water supplies. Naturally, predators and decomposers suffer similar fates. Unusually moist conditions will, of course, have the opposite effect. The numbers and distributions of almost all species will be increased.

Animals can sometimes alter and/or destroy their own environment. Wild horses, burros, mule deer or livestock can overpopulate an area and overgraze it to the point where it can no longer satisfy their needs. Also, exotic animals (ususally accidentially introduced by man) can sometimes adapt so readily and reproduce so rapidly that they nudge native animals out of an area. This has been the case where many endemic fish are losing out to tropical fish and Gambusia, and burros are driving out bighorn sheep.

Plants can also alter an ecosystem. As the result of a number of factors (livestock overgrazing, too much fire control, drought conditions, etc.), pinyon/juniper woodlands are spreading rapidly in the Caliente Planning Unit. The combination of shade and allelopathic substances (substances which inhibit the growth of competing species) which these trees produce and water they consume, is eliminating understory grass, browse and forbs. Only a few animals are adapted to life in a solid pinyon/juniper stands; the other animals must move out of these areas.

Humans, of course, can do much to alter the environment. Agriculture, mining, construction, etc. can drive native plants and/or animals out of an area or form new ecosystems where monoculture plants (like alfalfa or crested wheatgrass) can become the primary producers, cows, sheep, or horses can become the main herbivores and wild dogs can become the predators. Man can also indirectly affect the ecosystem, as stated earlier, through the introduction of exotic animals or plants and by interfering with natural processes like wildfires.

D. Human Components

1. Landscape Character

There is a wide variety of views and changes in landscape character over this 6 million+ acre area. Stark, gray dry lakes like the one east of the Arrow Canyon Range are in sharp contrast to the high rugged mountains that make up the Highland Peak Range.

Colors vary with the seasons and the year. It is possible for one to see white-capped Virgin Mountains during the winter, golden cottonwoods along the Meadow Valley Wash in autumn, the blue, trickling waters of Quaking Aspen Spring in summer and a kaleidoscope of desert flowers during the spring of a wet year. But during a dry year the landscape may take on a homogeneous grayish-brown hue.

There are several breathtaking views present in the study area. One can see for miles around on a clear day from atop Ella Mountain. The contrast of the red sandstone formations of Valley of Fire (see photograph) or the banded cliffs of the Arrow Canyon against the clear blue Nevada sky is beautiful at any time of the year.

There are very few distracting developments on the landscape within this sparsely populated study area. Noise and odors are also at a minimum. Many areas (like the Virgin Mountains, Arrow Canyon Range and Pahroc Mountains) still appear to be "untouched" by civilization and are being considered for possible "primitive" designation.

2. Socio-Cultural

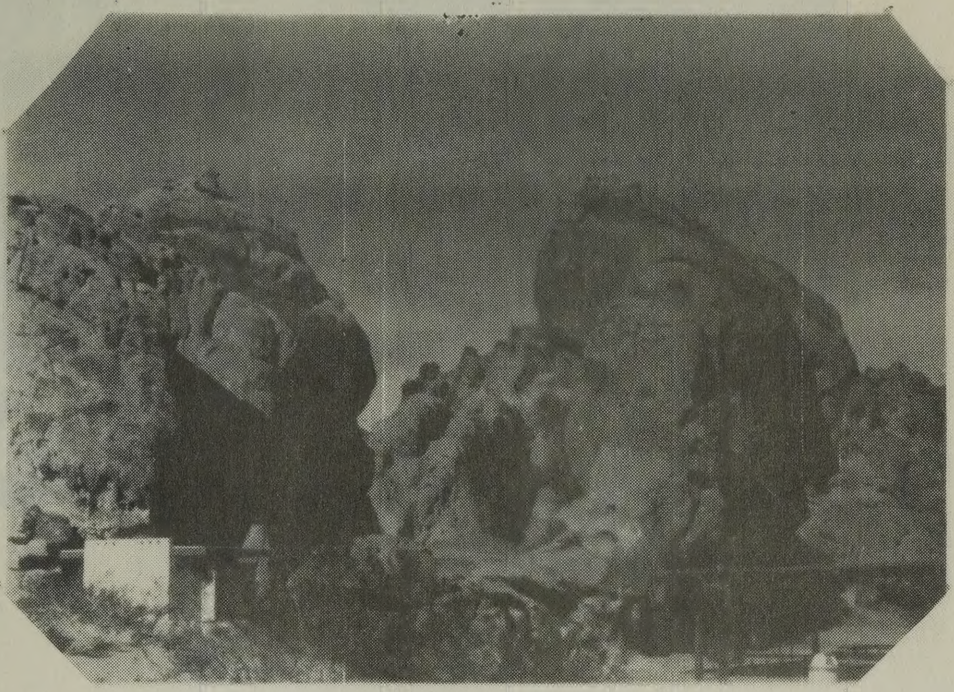
a. Archeological Values

Numerous petroglyph, burial grounds, pictographs, shelter, rock ring and camp sites have been identified throughout the Caliente and Virgin Valley Planning Units and many more may yet be discovered. In the Virgin Valley Unit, the Moapa-Muddy Creek area is particularly important archeologically.

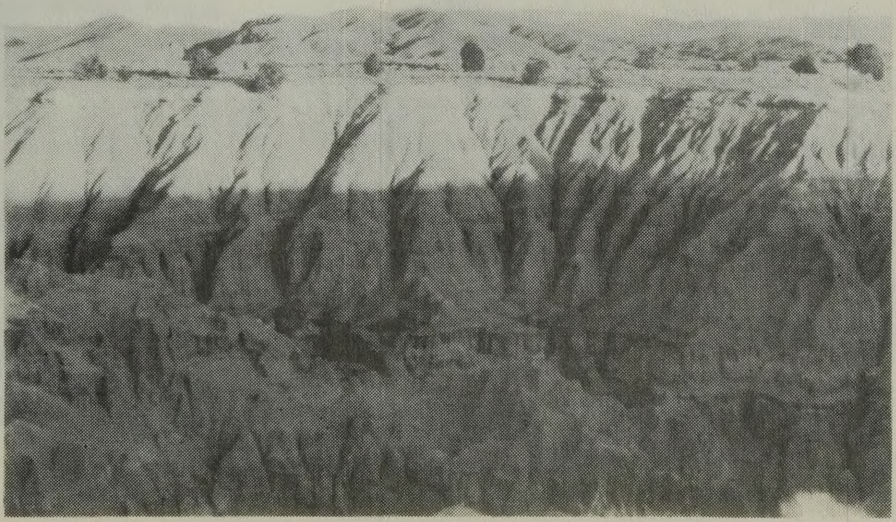
b. Historical Values

There are many historical sites present in the study area. The Delamar Ghost Town is well preserved and receives about 500 visitor day use/year. Many abandoned old buildings, farms and railroad stops are found in the Moapa-Muddy Creek area. The Panaca charcoal kilns and the Caliente railroad station, (both of which are nominated for the National Register of Historic Places, see photos), are important sites in the Caliente Planning Unit. While Bunkerville and the Mesquite House are important in the Virgin Valley Planning Unit. The Old Spanish Trail coincides with the Arrowhead, California and Mormon Trails in the study area.

Unique features of landscape character in Caliente and Virgin Valley Planning Units:

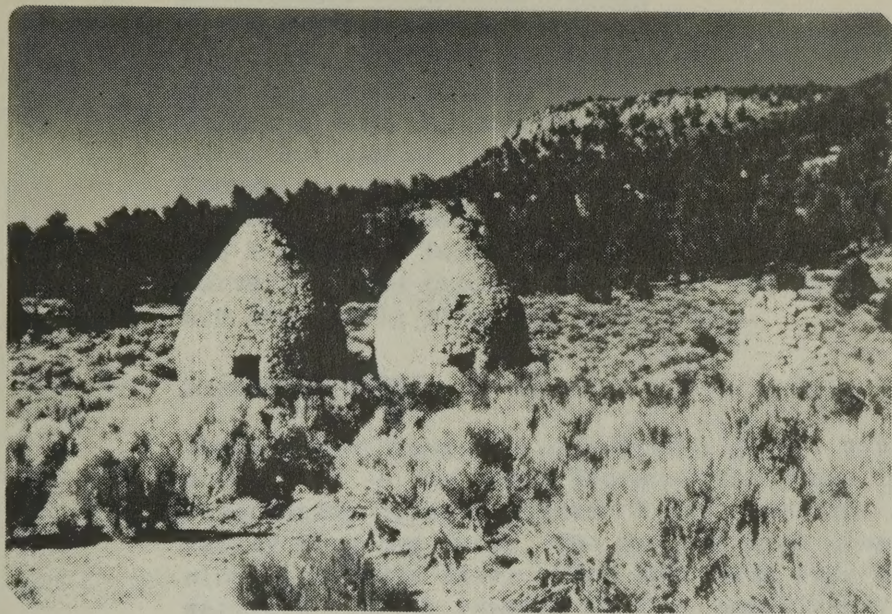


Scenic picnic area in the Valley of Fire

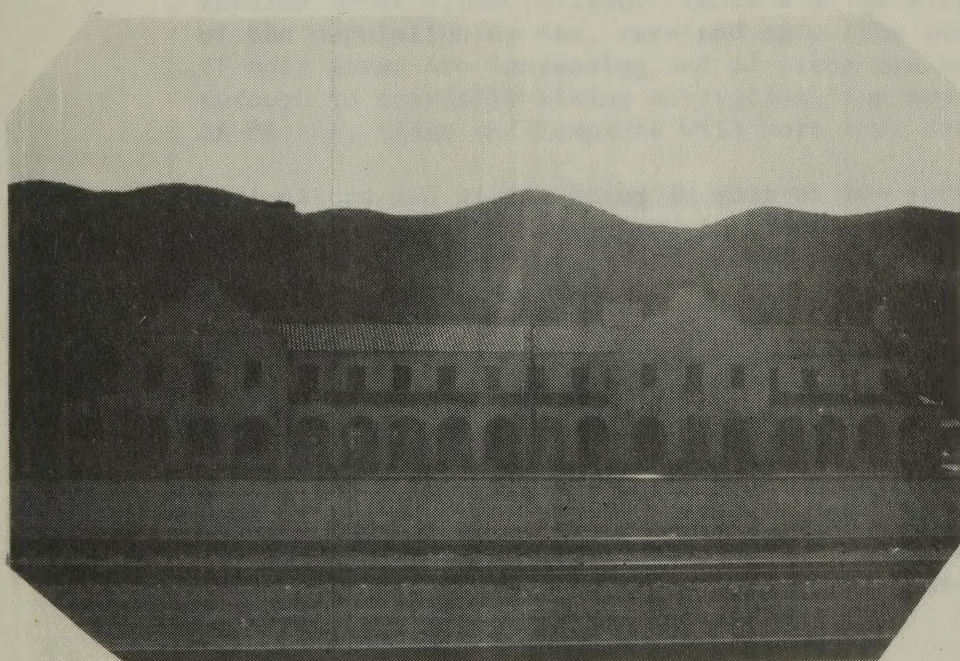


Cathedral Gorge

Historical Sites in Caliente:



Panaca charcoal kilns



Caliente railroad station

c. Educational-Scientific Values

The Caliente and Virgin Valley Planning Units contain many colorful geologic formations (e.g. Valley of Fire), unique plants and animals (e.g., native palms, endangered species of fish) and complicated ecological relationships which are of interest to the educational and scientific communities. The University of Nevada at Las Vegas, the Desert Research Institute, U. S. Geologic Survey, Nevada Department of Fish and Game and others are constantly studying these areas.

d. Cultural Values

There are at least three cultural groups present in the study area -- the Moapa Indians (the Moapa Indian reservation which consists of 999 acres in the Virgin Valley Planning Unit), the agricultural communities along the Muddy River which descended from early Mormon settlers and the remnant mining communities.

e. Socio-Economic Considerations

The communities included in the area covered by this environmental analysis include Alamo, Ash Springs, Bunkerville, Caliente, Logandale, Mesquite, Moapa, Overton, Panaca and Pioche. The populations of these areas totaled about 4,600 in 1970. Table 4 gives a breakdown of the population by sex, race and age. The populations of most areas are increasing and if plans are carried through to intensify mining activities, the populations of Pioche, Alamo and Tempiute will more than double.

Agriculture and mining bring in most of the revenue in the study area. For instance, in Lincoln County, 69% of the income (more than $1 million/year) is derived from livestock activities.

Some income is also derived from recreationists. In 1974, 690 hunters spent 2358 days deer hunting in the Beaver Dam Management Area 24 while 44 hunters spent 111 days in the Virgin Mountain Area. Nearly 50,000 hunter days were expended in Lincoln and Clark counties, seeking sage grouse, chukar, quail, rabbit and dove in 1974. Expenditures were also made by fishermen as well as non-consumptive users of wildlife (campers, sight-seers, photographers, etc.)

f. Attitudes and Expectations

Opinions about geothermal development in the study area is probably divided among farmers, ranchers, miners and others. But because of the energy crisis, support today for exploration and development of geothermal resources is stronger than it would have been five years ago.

g. Local Regulatory Agencies

Local regulatory agencies include Clark County Air Pollution Department, Nevada State Highway Patrol, Clark and Lincoln County Zoning Commissions, and Clark and Lincoln County Boards of Commissioners.

IV. Analysis of the Proposed Action

A. The Proposed Action

1. Anticipated Impacts

a. Non-Living Components

Air and Air Quality

During the implementation of the proposed action, air pollution will result from gases, vapors and particulate matter. Internal combustion engines (machinery, vehicles, aircraft, etc.) used during exploration, development, operations and abandonment will add exhaust by-products to the atmosphere. Accidental fires caused by sparks from equipment, burning of waste, ignition of combustible materials, etc. (usually during the development and operations stages) will result in smoke and airborne particles.

Dust will be the major form of particulate matter. The clearing and grading of the site, construction of roads and trails, installation of pipelines, use of off-road vehicles and movements of men and equipment to, from and around the site will raise dust throughout all stages of implementation.

During development, geothermal wells will be vented into the atmosphere to determine flow characteristics and to clear out the borings. The result will be that many gases (carbon monoxide and dioxide, methane, hydrogen, nitrogen, argon, radon, hydrogen sulfide, and ammonia) will be released into the air. Under normal circumstances, because less than 3% of the steam is composed of these gases, they are not a problem. But during

Table 4 Population Characteristics[1]

Town	Town Population 1960	1970	1990[2]	Sex M	F	Race[3] W	B	O	Age[4] Med.	18	65
Alamo	317	398	800[5]	207	191	397	--	1	23.3	47.2	6.0
Ash Springs	---	30									
Bunkerville	200	244		124	120	241	--	3	23	44.7	7.0
Caliente	960	979	1261-1346	439	540	917	7	55	28.4	41.5	13.6
Logan	809	426	---	209	217	317	4	51	18.6	50.7	6.1
Mesquite	517	674		364	310	665	--	9	22.0	43.8	7.6
Moapa	432	353		187	166	225	--	128	26.0	41.9	7.1
Overton	1162	1336		659	677	1286	--	50	27.3	39.1	12.3
Panaca	458	539	700-770	244	295	539	--	--	23.8	46.2	8.3
Pioche	696	641	829-1425[5]	332	309	635	--	6	31.9	34.8	9.2

[1] U.S. Bureau of Census, 1970
[2] Lincoln County Master Plan, 1974
[3] Race - White Black Other
[4] Age (in percentages - Median Age, 18 years of age, 65 years of age
[5] Estimate assumes mining activities will resume by 1990

air inversions or in the case of a blow out that expels sufficient quantities of gases, air pollution could result in a health hazard for employees and nearby residents.

During oil and gas development even more air pollution is created than during geothermal operations. This could be particularly troublesome near an already smoggy metropolis like Las Vegas.

Lands

Oil, gas and geothermal exploration, development and production could have several adverse impacts on the land and land use.

The drill site (area from less than 1 to 2½ acres in size) will be cleared of vegetation and graded. The removal of vegetation and disruption of the desert pavement will leave the affected area exposed to wind and water erosion. The construction of roads, reserve pits, parking areas, etc. will have a similar effect on fragile watershed areas surrounding the site. Compaction of these areas will reduce infiltration rates and seedling emergence.

Accidents like crude oil or chemical spills and blowouts can cause soil pollution. Blowouts could, also in freak incidents, create craters (a blowout in California's Geysers area in 1970 caused a 50-foot crater).

It's possible that deep well injection (placement of waste back into the earth) could result in enough heat and high pressure to fracture and readjust the surrounding geologic strata and change the permeability of this strata. Subsidence of the ground surface over and around the geothermal reservoir may also result if too large volumes of fluids are withdrawn.

Oil, gas and geothermal development may also conflict with some of the land uses described in III. Recreation (hunting, fishing, rockhounding, picnicking, camping, etc.), proposed primitive areas (like Arrow Canyon, Virgin Mountains and Pahroc Range), agriculture, mining claims, rights-of-way, crucial wildlife habitat areas shown on Maps #12 and 13, acquisition of certain Federal lands by Nevada State Parks and other uses may be at odds with a plant, depending on its location.

air inversions or in the case of a blow out that spews sufficient quantities of gases, air pollution could result in a health hazard for employees and nearby residents.

During oil and gas development even rock air inversion is created than during geothermal operations. This could be particularly troublesome near an already smoggy metropolis like Las Vegas.

Land

Oil, gas and geothermal exploration, development and production could have several adverse impacts on the land and land use.

The drill site (areas from less than 1 to 10 acres in size) will be cleared of vegetation and graded. The removal of vegetation and disruption of the desert pavement will leave the site and area exposed to wind and water erosion. The construction of roads, cluster pits, parking areas, etc. will have a similar effect on fragile watershed areas surrounding the site. Compaction of these areas will reduce infiltration rates and seedling emergence.

Accidents like crude oil or chemical spills and blowouts can cause soil pollution. Blowouts could, also in freak incidents, create craters (a blowout in California's Geysers area in 1976 caused a 50-foot crater).

It's possible that deep well injection (placement of waste back into the earth) could result in small, local and high pressure to fracture and readjust the surrounding geologic strata and change the permeability of the strata. Subsidence of the ground surface over and around the geothermal reservoir may also result if too large volumes of fluids are withdrawn.

Oil, gas and geothermal development may also conflict with some of the land uses described in III. Recreation (hunting, fishing, rockhounding, picnicking, camping, etc.), proposed primitive areas (like Arrow Canyon, Virgin Mountains and Parrot Canyon), wildlife, mining claims, rights-of-way, crucial wildlife habitat areas shown on Maps 12 and 15, acquisition of certain Federal lands by Nevada State Parks and other uses may be at odds with a plant, depending on its location.

Water

Oil, gas and geothermal actions can have a profound effect on water resources.

Accidental spills (oil or geothermal fluids), seepage, the overflow of sumps, or blowouts can add toxic, heavily mineralized or heated waters into streams, ponds and underground water supplies, contaminating them. There is also a remote possibility that inaccurate deep well injection or the inability to contain the waste within the desired strata can result in the contamination of ground water supplies.

Mercury, one of the gases that can be released during geothermal drilling, is washed into underground waters. The concentration in these waters usually remains below the maximum level deemed safe for drinking. But the mercury accumulates in plankton and algae in springs fed by this water and is passed on through the food chain, becoming more concentrated at each step of the chain. (Refer to Geothermal E.I.S.: Vol. I).

Still another possible impact of the proposed action is that water withdrawn for geothermal activities could lead to a decrease in streamflow throughout the drainage basin. In areas as arid as those in southern Nevada, this may be an important consideration.

There are at least two benefits of geothermal production. The clearing of some vegetation will reduce water loss through evapotranspiration. Also, if saline waters that result from geothermal operations can be salvaged and purified, new sources of water for human and animal consumption can result. Waste thermal waters can also be made available for maintaining year-round heated green houses for crop cultivation.

Hazards

Some of the hazards associated with oil, gas and geothermal production have already been discussed. Accidental fires or blowouts can endanger employees and nearby residents. The air quality in the vicinity of the plant can be degraded by the escape of hydrogen sulfide (which is toxic at concentrations of only 20ppm), ammonia (which can cause headaches, skin and eye irritations), carbon monoxide, inhalation of which leads to headache, drowsiness, nausea or sometimes death, and other toxic gases. The following table* shows toxicity levels for these various gases:

Gas	Toxicity Level
Ammonia	50 ppm
Boric acid	None established
Carbon dioxide	5,000 ppm
Carbon monoxide	100 ppm
Hydrogen sulfide	20 ppm
Mercury	12.2 ppb
Methane	10,000 ppm

*Taken from Webb, 1974

As stated earlier, land subsidence can occur during full scale geothermal production unless replacement fluid is returned to the reservoir. Instability or seismic activity may also result from pressure changes produced either by this withdrawal of fluids or the injection of fluids back into the earth (this can occur in both geothermal and petroleum production).

Another hazard to employees not mentioned before is asbestos (alone or in combination with fiberglass) which is used as insulation around pipelines, sheathing on cooling towers, etc. This substance can be inhaled during fabrication, storage or field installation with serious consequences.

Noise is an important hazard produced during oil, gas and geothermal operations. Vehicle movement, well drilling, steam venting and other discrete operations produce noise levels which can adversely affect employees and human and wildlife inhabitants of the area.

Clearing of vegetation, building of new roads and other actions that would increase erosion, could simultaneously intensify the flood hazard that already exists in the Caliente and Virgin Valley Planning Units.

b. Living Components

Vegetation

Vegetation would, of course, be totally removed in some areas (drill site, new roads, parking areas, etc.). In areas in the vicinity of the plant, it would be damaged by off-road vehicles or foot travel by workers. Accidents like fires or oil and chemical spills will also damage vegetation near the site. In large areas of creosote, pinyon-juniper or barren wastes, the loss of vegetation may not be noticed. But damage in important

botanical areas (like the native palm stand near Warm Springs or Joshua tree stands near Delamar) can be critical and irreversible.

After abandonment of the projects, rehabilitation of the disturbed area will be difficult. The arid conditions of these two planning units make the reestablishment of plants a slow proposition. Most likely, less desirable species (like thistle and cheatgrass) will be the first to naturally reinvade the abandoned area.

Wildlife, Livestock, Wild Horses and Burros

Oil, gas and geothermal productions would have the greatest impact on the animals present in the two planning units and their habitat. The impacts would start during the exploratory stage and continue right through the abandonment stage. N.D.F.&G. speculates that the loss of fish and wildlife populations and habitat can and probably will occur in proportion to the amount of land area devoted to geothermal, gas and oil exploration and development.

There would be some direct adverse effects on terrestrial animals. Noise (caused by aircraft used during surveys, vehicles, men, drilling, venting steam, etc.) will interfere with wildlife distribution, breeding patterns and predator/prey relationships. This would be most intense within a 500-foot radius of the project.

Power distribution lines in flyways or near nesting and feeding sites of birds of prey (high density areas like the Delamar region or the Virgin Mountains would be most affected) can lead to death through collision and/or electrocution.

Death by automobile collisions will increase for rabbits, deer, rodents, tortoises and other animals as new roads are added.

Less tolerant wildlife species - bighorn, sage grouse, mountain lion - will probably move out of the vicinity during development and operation. Some like sage grouse may move out permanently. This impact would be particularly detrimental to the populations of animals if the areas they were forced to leave were sites of permanent water supplies. Other, more tolerant species - wild horses and burros, rodents, rabbits, some birds - may be initially startled during the exploration and development phases, but will probably adapt to the human activity during operation and remain nearby.

Oil, gas and geothermal development will also indirectly affect animals by altering their habitat. The loss of plants discussed under "Impacts on Vegetation", would result in a loss of forage (palatable grasses, forbs and browse) and cover for wildlife, livestock, horses and burros. In crucial wildlife areas outlined in "Description of Existing Environment -- Wildlife", this would be disasterous. As mentioned earlier, after abandonment, less desirable vegetation may reinvade the area, and good forage will be lost permanently. Also, roads will remain, providing access for poachers into previously isolated areas.

Aquatic wildlife species and their habitat could also be seriously affected by the proposed action. Accidental spills, seepage and blowouts could release toxic, mineralized or heated water into any nearby stream or pond, altering habitat for fish, invertebrates and waterfowl. Harmful accumulations of mercury can develop in aquatic organisms and be passed onto waterfowl, amphibians and birds of prey through the food chain.

The increased potential for erosion discussed earlier could lead to increased siltation in streams, making them more shallow and thus decreasing favorable spawning and feeding habitat for fish.

The species that might be most affected by geothermal activities are the many protected fish existing in thermal springs throughout the two planning units. Since thermal springs are indicators of good sites for exploration, it is logical that most of the activity will be taking place near these springs. Over the years fish like the Moapa dace, White River springfish and Pahranagat bonytail have adpated themselves to very unique habitat conditions (specific temperature ranges, mineral content, etc.). The effect of withdrawal of geothermal fluids from the under-ground water supplies that feed these springs, the accidental water pollution, siltation and other accompanying impacts could eliminate these sensitive populations of fish. If closed loop (binary) systems are employed, and there is not fluid withdrawal, the fish may not be affected.

Some oil, gas or geothermal operations may include sumps in their designs. If the water in these ponds is free of toxic materials, favorable aquatic habitat could be developed for waterfowl and shorebirds. If, on the other hand, the water contains toxic concentrations of harmful substances, it would present a danger for birds, reptiles, mammals and invertebrates that approach it.

As a whole, an oil, gas or geothermal project would be detrimental to almost all forms of animals in an area, the degree of adversity depending on the location of the project. A project located in a crucial area (one that contains an endangered species, or contains valuable forage or water sources for wildlife, livestock, horses and burros) could do irreparable harm to animal populations and their habitat.

A subsequent drop in revenues from hunting and fishing and a decrease in the quality of these forms of recreation would be secondary impacts of oil, gas and geothermal operations.

c. Ecological Interrelationships

The proposed action would have an adverse effect on ecological interrelationships because of the way it can alter animal/animal, animal/plant and plant/plant interactions. During exploration, not much damage will occur. Some vegetation will be disturbed by off-road vehicle travel and some especially skittish animals will be frightened by the new disturbance.

During development and operation of the plant, the impacts will be longer lasting and more extensive. Vegetation will be cleared away, eliminating primary food producers from the vicinity. Naturally the herbivores that rely on this food will also be forced to leave. In turn, the predators and scavengers that use these herbivores will seek better hunting grounds elsewhere. Decomposers (bacteria, fungi, etc.) may be adversely affected by soil or water pollution that results from accidents.

Aquatic interrelationships would be similarly affected. Siltation or water pollution could reduce the productivity of algae and plankton. Shrinking food supplies, would, in turn, reduce populations of fish, amphibians, reptiles, and waterfowl and shorebirds. In an area as arid as southern Nevada, any reduction or altering of aquatic habitat must be considered a major loss.

d. Human Components

Landscape Character

The proposed action will have a major effect on landscape character. Presently many of the valleys are

large, open expanses of low growing vegetation; unobstructed visibility can extend in any direction for miles. Once development of a gas, oil or geothermal project begins, roads, pipelines, ponds, drills, transmission lines and buildings will appear. If poorly designed (large shiny silver pipes, metallic roofs visible for miles, etc.), there will be a large adverse visual impact. It should be remembered that the visual impact will not be limited to a small site but will extend along linear corridors (transmission lines and roads) radiating from the site.

After abandonment, even if the buildings are torn down, evidence of the site will remain for many years.

Adverse impacts on landscape character would be most disasterous in proposed primitive areas (Arrow Canyon, South Pahroc Mts., Virgin Mts.).

Socio-cultural Values

Any uninventoried archeological sites in the vicinity of the project will probably be destroyed during the activity.

If an oil, gas or geothermal discovery is made, the proposed action will require many skilled people to carry out the operation. During exploratory deep drilling, about 40 employees will be directly involved and another 10-20 will be intermittently needed to provide services. During development and operation 40-90 people may be needed. All in all, about 40-90 families will be introduced into an area temporarily. During operation, the number will taper off to a little over 30 families. After abandonment, of course, there will be no need for a permanent staff. (Refer to Webb, 1974, for a discussion of personnel needs).

The effect of this large staff will vary depending on where the project is located. If it is in the Virgin Valley Planning Unit, near Las Vegas, the new families will be easily absorbed into the metropolis. In fact, many of the employees will probably be people already living in Las Vegas.

On the other hand, if the project was located near a small town like Alamo, the large influx of people into the area would put a great strain on the services, school system and housing of the community.

large, open expanses of low growing vegetation) noncontinuous visibility can extend in any direction for miles. Once development of a gas, oil or geothermal project begins, roads, pipelines, ponds, drills, transmission lines and buildings will appear. If poorly designed (large shiny silver tanks, metallic roofs visible for miles, etc.), there will be a large adverse visual impact. It should be remembered that the visual impact will not be limited to a small site but will extend along linear corridors (transmission lines and roads) radiating from the site.

After abandonment, even if the buildings are torn down, evidence of the site will remain for many years.

Adverse impacts on landscape character would be most disastrous in wildland recreation areas (Grand Canyon, Zion, North Kaibab NRA, Virgin Mts.).

Socio-cultural Values

Any undiscovered archaeological sites in the vicinity of the project will probably be destroyed during the activity.

If an oil, gas or geothermal discovery is made, the proposed action will require more skilled people to carry out the operation. During exploratory well drilling, about 40 employees will be directly involved and another 10-20 will be intermittently needed to provide services. During development and operation 40-90 people may be needed. All in all, about 20-90 families will be introduced into an area temporarily. During operation, the number will eventually go to a little over 30 families. After abandonment, of course, there will be no need for a permanent staff. (Sater et Webb, 1974, for a discussion of geothermal needs).

The effect of this large staff will vary depending on where the project is located. If it is in the Virgin Valley Planning Unit, near Las Vegas, the new families will be easily absorbed into the metropolis. In fact, many of the employees will probably be people already living in Las Vegas.

On the other hand, if the project was located near a small town like Alamo, the large influx of people into the area would put a great strain on the services, school system and housing of the community.

But there could be some economic benefits derived from oil, gas and geothermal production. Electric power from a geothermal field may be used by adjacent communities.

Heat may be extracted from geothermal fluids for purposes other than power generation: space heating, green houses, etc. It is also possible that valuable chemicals and potable water may be extracted. Businesses in nearby communities will benefit from increased human activity in and around the site. After the first few years, the increased tax base (resulting from increased populations), may begin to benefit small communities. Oil, gas and geothermal production will result in revenues for Federal, state, county and private sources and help to ease the energy shortage.

2. Possible Mitigating Measures

In general, the lessee should comply with Federal, state and local laws and regulations, geothermal exploration and leasing regulations, Geothermal Resources Operations Orders and all lease and land use stipulations.

The following standard stipulation already appears on oil, gas and geothermal leases:

> PROTECTION OF THE ENVIRONMENT (LAND, AIR AND WATER) AND IMPROVEMENTS--The Lessee shall take all mitigating actions required by the Lessor to prevent: (a) soil erosion or damage to crops or other vegetative cover on Federal or nonFederal lands in the vicinity; (b) the pollution of land, air, or water; (c) land subsidence, seismic activity, or noise emissions; (d) damage to aesthetic and recreational values; (e) damage to fish or wildlife or their habitats; (f) damage to or removal of improvements owned by the United States or other parties; or (g) damage to or destruction or loss of fossils, historic or prehistoric ruins, or artifacts. Prior to the termination of bond liability or at any other time when required and to the extent deemed necessary by the Lessor, the Lessee shall reclaim all surface disturbances as required, remove or cover all debris or solid waste, and, so far as possible, repair the offside and onsite damage caused by his activity or activities incidental thereto, and return access roads or trails and the leased lands to an acceptable condition including the removal of structures, if required. The Supervisor or the Authorized Officer shall prescribe the steps to be taken by Lessee to protect the

surface and the environment and for the restoration of the leased lands and other lands affected by operations on the leased lands and improvements thereon, whether or not the improvements are owned by the United States. Timber or mineral materials may be obtained only on terms and conditions imposed by the Authorized Officer.

Specifically the following actions would tend to eliminate, diminish or correct environmental damage resulting from oil, gas and geothermal exploration and production:

a. In order to reduce adverse effect on air quality:

(1) All garbage and foreign debris should be removed to a suitable disposal site; allow no open burning of trash to prevent air pollution and chance of fires.

(2) Main access roads should be graded, drained and surfaced; unsurfaced roads should be watered to reduce dust.

(3) Drill site pads should be treated to prevent dust.

(4) The release of noxious gases into the atmosphere around the plant should be monitored to detect excessive pollution.

b. To reduce potential for erosion, soil pollution and other other adverse impacts on lands:

(1) Off-road vehicle travel should be restricted when silty and clayey soils are wet or muddy.

(2) Heavy-vehicles should be restricted to existing roads, trails and washes as much as possible; avoid travel on fragile watershed areas shown under "Description of the Existing Environment".

(3) Initial access roads to abandoned exploratory well sites should be closed and reclaimed. Removed vegetative matter and topsoil should be saved to scatter over abandoned roads and drill sites to reduce erosion. Water diversions (culverts, water breaks, etc.) should be built near permanent roads to reduce erosion.

(4) The reinjection of geothermal fluids should be monitored to reduce possibility of generating seismic activity.

(5) Drill sites should be located on near-level terrain, away from drainages. Dikes should be installed to catch any overflow of toxic sumps.

(6) Emergency access to earth-moving equipment, straw and/or other material needed to quickly control an oil spill should be provided; holding tanks should be surrounded by impermeable dikes or berms to hold spilled oil.

(7) Primitive and natural areas described in the Appendix should be protected.

c. To prevent or reduce contamination of surface and ground water supplies:

(1) Mitigating measures #5 and 6 under soil should be enforced.

(2) Suitable sealant material should be used to line evaporation ponds to prevent leakage.

(3) If a test well is abandoned, it should be properly plugged.

(4) Toxic geothermal fluids should not be disposed of in surface waters or in dry washes.

(5) Any injection well programs should be planned so as to avoid degradation of ground water resources within the geohydrologic basin involved.

d. To reduce potentially hazardous conditions to employees and nearby residents and minimize conflicts with other land uses:

(1) Mitigating measures #1 and 4 under air quality #4 under lands should be enforced.

(2) No surface occupancy should be allowed on rights-of-way (and their accompanying material deposits) listed in the appendix.

(3) Prior to exploration and leasing on areas identified as expansion areas for Nevada State Parks (see Appendix) formal contact should be made with the Administrator, Nevada State Park System.

e. To reduce or compensate for damage to vegetation:

(1) Mitigating measures #1 under Air Quality, #2, 3, 6, and 7 under Lands should be enforced.

(2) All areas scalped, should be rehabilated, graded or surfaced after abandonment of the project; lessee should replant or reseed with native species if feasible. Allow 10 years to evaluate the effectiveness of this rehabilitation.

(3) Precautions should be taken against fires spreading, particularly around oil and gas wells.

(4) Those unique botanical areas outlined in the Appendix should be protected.

f. To relieve or eliminate impacts on wildlife, livestock, wild horses and burros, their habitat and ecological interrelationships:

(1) Mitigating measures #1 under Air Quality, #2, 3, 6 and 7 under Lands, #2-5 under Water and #2-4 under Vegetation will also indirectly benefit wildlife and ecological interrelationships.

(2) Toxic sumps and ponds should be fenced to protect animals in the area; they should also be covered if necessary to prevent waterfowl from landing in them. Upon abandonment, harmful chemicals should be removed or the sumps should be filled and revegetated.

(3) Plan exploratory activities around springs in such a way as to leave sufficient water available for wildlife, livestock, horse and burro use. This is particularly important for protected fish in thermal springs.

(4) If water quality of sumps or of wells and pipelines is good, some water should be made available to animals in the area.

(5) Electrical transmission lines should be designed to minimize bird loss through collision or electrocution (see recommended guidelines in REA Bulletin 61-10).

(6) A variety of native grasses, forbs and shrubs should be used to revegetate disturbed areas.

(7) Crucial wildlife areas described in the Appendix should be protected.

(8) Aid of U.S. Fish and Wildlife Service should be solicited in identifying any crucial wildlife areas (like habitat for spotted bats or falcon nesting sites) that may need protection from specific developments.

g. To minimize adverse impacts on human components:

(1) The following stipulation (which is standard on oil, gas and geothermal leases) should be enforced:

ANTIQUITIES AND OBJECTS OF HISTORIC VALUE--The Lessee shall immediately bring to the attention of the Authorized Officer any antiquities or other objects of historic or scientific interest, including but not limited to historic or prehistoric ruins, fossils, or artifacts discovered as a result of operations under this lease, and shall leave such discoveries intact. Failure to comply with any of the terms and conditions imposed by the Authorized Officer with regard to the preservation of antiquities may constitute a violation of the Antiquities Act (16 U.S.C. 431-433). Prior to operations, the Lessee shall furnish to the Authorized Officer a certified statement that either no archaeological values exist or that they may exist on the leased lands to the best of the Lessee's knowledge and belief and that they might be impaired by geothermal operations. If the Lessee furnishes a statement that archaeological values may exist where the land is to be disturbed or occupied, the Lessee will engage a qualified archaeologist, acceptable to the Authorized Officer, to survey and salvage, in advance of any operations, such archaeological values on the lands involved. The responsibility for the cost for the certificate, survey, and salvage will be borne by the Lessee, and such salvaged property shall remain the property of the Lessor or the surface owner.

(2) All survey monuments, witness corners, reference monuments, bearing trees or mining claim markers

should be protected against damage or destruction. Lessee should report any damage to these markers or any need to remove them to the District Manager.

(3) Project design and architecture should be harmonious with the desert landscape. Drill site clearings should be irregular. Color schemes (of pipelines, buildings, etc.) should be non-reflective (metallic surfaces should be covered or painted) and blend in with the environment. Landscaping may be beneficial.

Strict compliance with the BLM visual resource management system procedures (BLM Manual 6300) should be required. Compliance will assure that visual intrusions will be lessened to acceptable levels or in some isolated cases might result in the rejection of a lease application .

(4) The areas containing unique natural and primitive values as listed in the Appendix should be protected through the exclusion of leasing or site-by-site investigations (see Appendix for recommended protection).

3. Recommendation for Mitigation

All of the mitigating measures discussed above are recommended for oil, gas and geothermal leasing, exploration and production in the Caliente and Virgin Valley Planning Units.

4. Residual Impacts

Despite the implementation of all or most of the recommended mitigating measures, there are several adverse impacts that cannot be avoided.

The change of soil structure, loss of native vegetation, wildlife, livestock, horse and burro forage and cover, increased air pollution and increased erosion potential are all impacts that can't be avoided when land is cleared and graded for drill sites (once development and production has begun). This will in turn alter the aesthetic properties and ecological interrelationships that exist. If the project takes place near a small town, sociological changes are inevitable as the new work force moves in.

Even after reclamation, which is a slow process, and, after the employees and their families have left the area, there will be remnants of the operation. Even with seeding and planting efforts, it will take years for native vegetation to be reestablished; for the scar to heal. There will also be an economic slump in the small community when the large work force leaves.

should be protected against damage of vegetation. Lessee should report any damage to these surveys or any need to resurvey them to the District Manager.

(3) Surface damage and architecture should be harmonious with the desert landscape. Drill site clearing should be irregular. Color schemes for structures, buildings, etc., should be non-reflective (earthtone) surfaces should be covered or painted and blend in with the environment. Landscaping may be beneficially

Strict compliance with the BLM visual resource management program procedures (BLM Manual 8400) should be required. Compliance will ensure that visual intrusions will be lessened to acceptable levels or in some designated areas might result in the rejection of a lease application.

(4) The areas containing unique cultural and prehistoric values as listed in the Appendix should be protected through the exclusion of leasing or with in-depth investigations (and approvals for their permanent protection).

3. Recommendation for Mitigation

All of the mitigating measures discussed above are recommended for oil, gas and geothermal leasing, exploration and production in the Caliente and Virgin Valley Planning Units.

4. Residual Impacts

Despite the implementation of all or most of the recommended mitigating measures, there are several adverse impacts that cannot be avoided.

The change of soil structure, loss of native vegetation, wildlife, livestock, horse and burro forage and cover, increased air pollution and increased erosion potential, are all impacts that can't be avoided when land is cleared and graded for drill sites (once development and production has begun). This will in turn alter the aesthetic properties and ecological interrelationships that exist. If the project takes place over a small area, unchanged impacts are inevitable as the new more dense

Even after rehabilitation, which is a slow process, and, after the employees and their families have left the area, there will be remnants of the operation. Even with seeding and planting efforts, it will take years for native vegetation to be reestablished; for the most to be. There will also be an economic change in the small community when the large work force leaves.

5. Relationship between Short-Term Use and Long-Term Productivity

The short-term exploration (1-2 years) would have little impact on the environment: small amounts of vegetation would be disturbed and only some species of wildlife would be temporarily displaced. If no discoveries are made, the exploration sites can be rehabilitated with little or no effect on long-term productivity of the ecosystem.

If oil, gas or geothermal resources are found and production occurs, the other resources in the vicinity of the plant will be adversely affected throughout the development of the project (up to 10 years). Nearby communities would be strained financially during early development.

Once production is begun, conditions will stabilize. Some tolerant animals (rodents, birds, burros) will adapt to the operation and move back into the area (as long as some forage and water remain available). The increased tax base may, in a few years, relieve the strain of the additional residents on nearby communities. Also the benefits of the operations (new sources of energy) will be felt during this period (25 or more years).

There will be a large let-down in productivity in the ten year period after the operation is abandoned. It will take a long time for native animals and plants driven out of the area to reestablish themselves, if they ever do. There will also be an economic let-down as employees and their families move out of the area. There is no guarantee that new families will move in to take their places and help maintain the increased tax base.

6. Irreversible and Irretrievable Commitment and Impacts of Resources

There could be several irreversible and irretrievable commitments of resources as a result of oil, gas and geothermal development. Of course, by the very nature of these projects, oil, gas or geothermal reserves will be permanently depleted. In addition, if care is not taken during selection and development of sites, of sites, unique plant and animal species (and the ecological interrelationships they play major parts in), archeological sites and aesthetic values may be lost forever. Water sources could be depleted through unsurption, pollution, compaction or land subsidence.

B. The Alternative

The major alternative is to allow no oil, gas or geothermal leases in the Caliente and Virgin Valley Planning Units at this time. In this case, of course, there would be no adverse effect

on lands, water, air quality, landscape character or archeological values, no irreversible or irretrievable commitments of resources. Also long-term productivity at the area would not be affected. There would be one major impact, however. There would be no developments of these potential energy sources and the increasing demand for energy would have to be met by other methods (importation of fuel or electricity from neighboring states, for example) at possibly greater expense.

V. Person, Groups and Government Agencies Consulted

Nevada Department of Fish and Game
U. S. Geological Survey
Nevada Highway Department
Nevada State Parks System
Division of Colorado Resource
Advisory Mining Board
Governor's Office of Planning Coordination
Department of Human Resource (Environmental Protection Services)

VI. Intensity of Public Interest

At the present stage, most interest comes from governmental agencies (NDF&G, U.S.G.S., etc.) and private companies interested in development. But when a specific oil, gas or geothermal development is proposed, it can be assumed that local residents and conservation groups will become aroused and interested in the plan.

VII. Participating Staff

Phillip Range - Caliente-Virgin Valley Resource Area Manager
James Gegen - Soil Scientist
Jorgen Matthiessen - Realty Specialist
Edson Griswold - Outdoor Recreation Planner
Richard Enriquez - Wildlife Specialist
Terry Driver - Range Conservationist
Frank Bingham - Chief, Division of Resources
Robert Sulenski - EIS Team Leader
Howard Wirtz - Geologist
Jack Howell - Carteographer
Brain Hatoff - Archaeologist

VIII. Summary

In conclusion, the proposed action discussed in this E.A.R. is the issuance of oil, gas and geothermal leases in the Caliente and Virgin Valley Planning Units of the Las Vegas District.

Development of oil, gas and geothermal resources can have significant effects on the environment. But if the recommended mitigating measures are instituted (particularly the on-the-ground investigations and the exclusion of leasing in the important wildlife and recreation areas outlined in the Appendix), irreversible and irretrievable impacts can be held to a tolerable minimum.

IX. References

Barngrover, Molini and Tsukamoto, 1975. Game Harvest Statistics. Nevada Department of Fish and Game. Reno, Nevada. 10 pp.

Brunner, J., 1974. Environmental Analysis Record: Delamar Valley Allotment Management Plans. Bureau of Land Management, Las Vegas, Nevada.

Bureau of Land Management, 1974. Unit Resource - Analysis Reports and Management Framework Plans for Caliente and Virgin Valley Planning Units. BLM, Las Vegas, Nevada.

__________, 1975. Final Regional Environmental Analysis on Geothermal Leasing in the Tonopah Resource Area. BLM, Battle Mountain, Nevada. 67 pp.

__________, 1975. Environmental Analysis Record on Alvord Desert Geothermal Leasing Program. BLM, Burns, Oregon. 64 pp.

Division of State Parks, 1971. Recreation in Nevada, Part III. Dept. of Conservation and Natural Resources. Carson City, Nevada. 319 pp.

Dodge, N., 1969. Flowers of The Southwest Deserts. Southwestern Monuments Association. Globe, Arizona. 112 pp.

Eakin, T., 1963. Ground Water Resources Appraisal of Garden and Coal Valley (Lincoln and Nye Co. Report 18). Department of Conservation and Natural Resources. Carson City, Nevada. 29 pp.

__________, 1963. Ground Water Appraisal of Pahranagat and Pahroc Valleys. Department of Conservation and Natural Resources. Carson City, Nevada. 36 pp.

Environmental Protection Agency. "Interim Drinking Water Standards" Federal Register Vol. 40, No. 51. March 14, 1975.

Fellow, Garrett & Link, 1974. Economic Profile Supplement. Bureau of Land Management, Reno, Nevada. 174 pp.

Glancy, P. & Van Denburgh, 1969. Water Resources Appraisal of Lower Virgin River Valley Area (Report 51). Department of Conservation and Natural Resources. Carson City, Nevada. 87 pp.

Development of oil, gas and geothermal resources can have significant effects on the sage grouse. But if the recommended mitigating measures are instituted (particularly for the sage grouse strutting area and the exclusion of leasing in the Toquima Range and the Toiyabe Range, outlined in the Appendix), irreversible and irretrievable impacts can be held to a tolerable minimum.

VI. References

Barngrover, Hollis and Teuscher, 1975. Sage Grouse Population. Nevada Department of Fish and Game. Reno, Nevada. 14 pp.

Brooks, J., 1975. Environmental Analysis Records: Delamar Valley Allotment Management Plans. Bureau of Land Management, Las Vegas, Nevada.

Bureau of Land Management, 1976. Unit Resource Analysis Battle Mountain Grazing Environmental Plans and Existing and Proposed Grazing Units. BLM, Las Vegas, Nevada.

______, 1975. Final Regional Environmental Analysis on Geothermal Leasing in the Tonopah Resource Area. BLM, Battle Mountain, Nevada. 47 pp.

______, 1975. Environmental Analysis Record on Alvord Desert Geothermal Leasing Program. BLM, Burns, Oregon. 96 pp.

Division of State Parks, 1971. Recreation in Nevada, Past, 1971. Dept. of Conservation and Natural Resources. Carson City, Nevada. 118 pp.

Dodge, N., 1969. Flowers of the Southwest Deserts. Southwestern Monuments Association. Globe, Arizona. 112 pp.

Eakin, T., 1961. Ground Water Appraisal Reconnaissance of Ralston and Stone Cabin Valley (Lincoln and Nye Co.) Report 18. Department of Conservation and Natural Resources. Carson City, Nevada. 35 pp.

______, 1963. Ground Water Appraisal of Railroad Valley and Tikaboo Valley. Department of Conservation and Natural Resources. Carson City, Nevada. 36 pp.

Environmental Protection Agency, "Interim Drinking Water Standards" Federal Register Vol. 40, No. 51. March 14, 1975.

Fallon, Garrett & Linn, 1974. Economic Profile Supplement. Bureau of Land Management, Reno, Nevada. 175 pp.

Glancy, P. & Van Denburgh, 1969. Water Resources Appraisal of Lower Virgin River Valley Area (Report 51). Department of Conservation and Natural Resources. Carson City, Nevada. 87 pp.

Meridith, D., 1974. Mammals, Fish, Reptiles & Amphibians - Las Vegas District. (Brochures) Bureau of Land Management, Las Vegas Nevada.

Miller, W., 1974. Application of Reclamation Techniques to Oil and Gas Surface Construction. Wyoming Geological Association Guidebook. Wyoming. pp. 225-238.

Patraw, P., 1970. Flowers of the Southwest Mesas. Southwest Parks and Monuments Association. Globe, Arizona. 112 pp.

Rural Electrification Administration, 1972. "Powerline Contacts by Eagles and Other Large Birds." REA Bulletin 61-10. U. S. Dept. of Agriculture. Washington, D. C. 8 pp.

Rush, 1968. Water Resources Appraisal of Lower Moapa-Lake Mead Area. Department of Conservation and Natural Resources. Carson City, Nevada. 66 pp.

Sulenski and Gegen, 1975. Programmatic Environmental Analysis Record: Off-Road Vehicle Use in the Dry Lake Valley Area. Bureau of Land Management, Las Vegas, Nevada.

U. S. Bureau of the Census, 1971. Number of Inhabitants: 1970 Census of Population. U. S. Government Printing Office, Washington, D.C. 16 pp.

__________, 1971. General Population Characteristics: 1970 Census of the Population. U. S. Government Printing Office, Washington, D. C. 66 pp.

U. S. Department of Commerce, 1973. Climatological Data: Annual Summary for Nevada (Vol. 88, No. 13) Environmental Data Service.

U. S. Department of Interior, 1973. Final Environmental Statement for Geothermal Leasing Program. U. S. Government Printing Office, Washington, D. C. 720 pp.

Webb, R., 1974. Technical Report on Geothermal Energy Development - Brady's Hot Springs and Fireball Valley Hydrographic Areas. Bureau of Land Management, Reno, Nevada. 46 pp.

Willie, J. & al., 1974. Preliminary Lincoln County Master Plan. Nevada State Planning Commission, Carson City, Nevada.

Wirtz, H., 1974. Environmental Analysis Record; Oil, Gas, and Geothermal Leasing Covering the Stateline Planning Unit. Bureau of Land Management, Las Vegas, Nevada. 42 pp.

Meredith, P. 1971. Mammals, Fish, Reptiles & Amphibians - Las Vegas District. (Processed) Bureau of Land Management, Las Vegas, Nevada.

Miller, R., 1974. Application of Reclamation Techniques to Oil and Gas Well Site Construction. Wyoming Geological Association Guidebook. Wyoming. pp. 227-238.

Patraw, P. 1970. Flowers of the Southwest Mesas. Southwest Parks and Monuments Association. Globe, Arizona. 112 pp.

Rural Electrification Administration, 1972. "Powerline Contacts by Eagles and Other Large Birds." REA Bulletin 61-10. U. S. Dept. of Agriculture. Washington, D. C. 8 pp.

Rush, 1968. Water Resources Appraisal of Lower Moapa-Lake Mead Area. Department of Conservation and Natural Resources. Carson City, Nevada. 58 pp.

Salenski and Cepek, 1975. Programmatic Environmental Analysis Record: Off-Road Vehicle Use in the Dry Lake Valley Area. Bureau of Land Management, Las Vegas, Nevada.

U. S. Bureau of the Census, 1973. Number of Inhabitants: 1970 Census of Population. U. S. Government Printing Office. Washington, D.C. 16 pp.

______, 1973. General Population Characteristics: 1970 Census of the Population. U. S. Government Printing Office, Washington, D. C. 60 pp.

U. S. Department of Commerce, 1973. Climatological Data: Annual Summary for Nevada (Vol. 88, No. 13) Environmental Data Service.

U. S. Department of Interior, 1973. Final Environmental Statement for Geothermal Leasing Program. U. S. Government Printing Office. Washington, D. C. 720 pp.

Webb, K., 1974. Resources Report on Geothermal Energy Development - Brady's Hot Springs and Fireball Valley Known Geothermal Areas. Bureau of Land Management, Reno, Nevada. 46 pp.

Willis, J. & al., 1973. Preliminary Lincoln County Master Plan. Nevada State Planning Commission, Carson City, Nevada.

Witte, G., 1974. Environmental Analysis Record - Oil, Gas, and Geothermal Leasing Covering the Virgin Valley Planning Unit. Bureau of Land Management, Las Vegas, Nevada. 67 pp.

X. Signatures

June 18, 1976
Date

Denise P. Meridith
Denise P. Meridith, Environmental Coordinator

Recommendation for Approval:

6/18/76
Date

Phillip J. Range
Phillip Range, Caliente-Virgin Valley Area Manager

6/21/76
Date

Frank P. Bingham
Frank Bingham, Chief of Resource Management

Approval:

6/25/76
Date

John S. Boyles
John S. Boyles, District Manager

XI. T E C H N I C A L   R E P O R T

Covering Oil and Gas Operations

To Accompany
Oil and Gas and Geothermal Resource
Environmental Analysis Records

Bureau of Land Management
Las Vegas District Office
Las Vegas, Nevada

Esmeralda, Caliente, Virgin Valley, and Stateline
Planning Units

in

Clark, Nye, Esmeralda, and Lincoln Counties

PREPARED BY:
Howard A. Wirtz
Geologist

Note: Geothermal Resource Developement is Covered in N-8672, Technical Report on Geothermal Energy Development.

Background and Description of the Proposal

Issuance of non-competitive oil and gas and geothermal resource leases in the Las Vegas District have been proposed. Leases will range between 640 and 2,560 acres in size. These leases will be non-competitive because the area is not within a known geological structure (KGS) in which case, only competitive leasing would be authorized. A separate Technical Report (N-8672) covers aspects of geothermal leasing. The proposal covers issuance of both regular and simultaneous offers to lease oil and gas. Regular offers are filed "over-the-counter" and issued on a first come - first served basis. Leases that have been extinguished for any reason are reoffered to the public at a simultaneous drawing. Those lease tracts having no simultaneous offers filed at the time of drawing, again become available for regular offers.

Non-competitive leases are issued for a period of 10 years at a rental rate of 50¢ per acre per year. If oil is actually produced, a royalty of 12% is charged.

All leases, prior to the beginning drilling operations, are subject to a bond of $10,000, per lease, a statewide bond of $25,000, or a nation-wide bond of $150,000.

Revenue obtained from oil and gas leases is broken down in the following manner:

52 1/2% to U. S. Bureau of Reclamation
37 1/2% to State of Nevada
10 % to U. S. Treasury

At present time, 2,700,000 acres are under lease in Nevada. These oil and gas leases will yield about 1/2 million dollars to the state per year. In addition, in 1969, counties in the State received $230,000 from taxes on leases held.

History of Oil and Gas Exploration in Nevada

Exploration for oil and gas in Nevada began in 1907 with the drilling of the Peavine Mountain Well near Reno. Prior to 1953, a total of 67 wells were drilled in Nevada, none of which encountered oil in commercial quantities. Most were shallow, few logs were run and much data from these test are presently unavailable.

A modern, comprehensive petroleum conservation law passed in 1953 created the Nevada Oil and Gas Conservation Commission with authority to issue well drilling permits and to require logs of wells to be made and filed with the commission.

Between 1953 and 1967, 104 tests were drilled in Nevada for oil and gas. In May, 1954, Shell Oil Company drilled the discovery well in what is now the Eagle Springs Oil Field in the east-central part of the Railroad Valley. Fourteen wells in this field have produced 2,606,587 barrels of oil through October, 1972. No gas has been produced from these or any wells in Nevada.

Drilling has been confined mainly to west central, northeast, east central and southern Nevada. Exploration activity, which was intense during the 1920's and from the late 1940's through the early 1960's, is presently recurring in response to an energy crisis.

Energy demands in the United States have doubled since 1950. Oil and gas amounted to 77% of our energy consumption in 1974. To satisfy this demand, domestic production of natural gas has trebled and petroleum doubled in the past 20 years. Nevertheless, there has been a growing reliance on imports, particularly petroleum. Currently, imports of crude oil and refined products amount of 50% of domestic demand as compared to 14% in 1950.

Despite the vast potential energy resources within its natural boundaries, the U. S. entered the winter of 1973-1974 with the sure knowledge that its energy supply would fall short of demand. Conservation of energy was necessary, because the limitations imposed by available technology, economics, and environmental regulations combined to block rapid production increases from existing energy sources. Large government appropriations for energy research will not begin to pay off for years to come. And higher prices for energy will not permit industry to tap previously uneconomic energy sources until the technology and industrial plant required for such production have been developed.

Vast tonnages of readily accessible coal would appear to offer potential for rapid increases in coal mine output thus relieving some of our dependance on oil--and between now and 1980, the coal industry will probably substantially increase its contribution to U.S. energy supply. Problems to be solved in achieving such an increase include environmental regulations which block the mining of hugh tonnages of coal accessible to surface mining methods and which restrict the burning of high sulphur coals to generate electricity. The problems arising from environmental controls eventually reflect back on the economics and technology of both coal mine production and coal utilization, and before the U.S. can realize the full potential of its coal resource, these environmental, technologic, and economic conflicts must be resolved. In the meantime oil (much of it imported) will continue to be our major energy source.

Oil and natural gas are currently the largest and second largest U. S. energy supply sources. Petroleum supplies 46% of domestic energy consumption; natural gas about 32%. The principal problem in dealing with these resources is domestic availability. Whereas the potential U.S. coal resource is high, the potential U.S. oil and natural gas resource is relatively small, and oil-gas consumption in recent years has been exceeding additions of new reserves. It is difficult to increase production to meet the short-term demands of an energy shortage.

Atomic energy has been argued to be the future savior of energy-short nations, but production of electricity by nuclear reactors is still an infant industry. Although growth in the industry between now and the end of the century is expected to be rapid, there is no way to force this growth at a rate that will solve short-term energy deficits.

Projected deficiencies for 1980 under various assumptions range from 8,000,000 barrels per day (41% of demand), to 16,200,000 barrels per day (65% of demand).

Attempts to meet these requirements and alleviate the energy crisis have stimulated and will continue to stimulate exploration in Nevada and the rest of the United States.

General Geology of the Area

The area covered by this EAR is part of the Basin and Range Province. North-south mountain ranges and valleys were formed by block faulting movements during the Tertiary period. Folding of various types as well as minor faulting have also contributed to the structure of the area which is quite complicated, but well exposed in this desert country of high relief.

Rocks in the area range in age from Cambrian age (550 million years ago) to recent. Paleozoic and Mesozoic rocks (starting with Cambrian) comprised of thick sections of limestones, shales, and sandstones were deposited in the Cordilleran Geosyncline (trough) until Cretaceous times (136 million years ago). After this time the area has been mostly out of water and undergoing erosion, faulting and folding as well as volcanic activity.

Several times the sedimentary rocks of the area have been intruded by bodies of molten igneous magma.

The formation of block mountains,with interior basins in which lakes were formed, and volcanic activity followed the emergence of the land. Later dissection by streams along with regional warping has left the land as it is today. Thick playa and lake deposits were formed in the intermountain areas with salt and gypsum indicating aridity. Crustal movements of considerable magnitude have occurred probably into Quaternary times (2-3 million years ago).

Oil and gas, formed under marine conditions, and often deposited in favorable horizons later migrated through suitable channels until trapped by some structural or stratigraphic feature. If subsequent folding and faulting has not caused these oil and gas accumulations to rupture and become lost, they are available to be tapped and utilized.

Eagle Springs Oil Field

Shell Oil Co. drilled the discovery well in the Eagle Springs Oil Field. In all, Shell drilled four producing wells and ten dry holes. From 1963 through 1967 Texota drilled six producing wells and three dry holes extending the producing limits of the field to the east and west. Beginning in 1965 Western Oil Inc. completed four producing wells bringing to fourteen the number of producing wells in the field.

Atomic energy has been argued to be the future source of our energy needs, but production of electricity by nuclear reactors is still an infant industry. Although growth in the industry between now and the end of the century is expected to be rapid, there is no way to force this expansion or insure that it will solve short-term energy problems.

Projected deficiencies for 1980 under various assumptions range from 4,500,000 barrels per day (21% of demand), to 16,300,000 barrels per day (38% of demand).

Attempts to meet these requirements and alleviate the energy deficit have stimulated and will continue to stimulate exploration in Nevada and the rest of the United States.

General Geology of the Area

The area covered by this EAR is part of the Basin and Range Province. North-south mountain ranges and valleys were formed by block faulting movements during the Tertiary period. Folding of various types as well as minor faulting have also contributed to the structure of the area which is quite complicated, but well exposed in this desert terrain of high relief.

Rocks in the area range in age from Cambrian age (570 million years ago) to recent. Paleozoic and Mesozoic rocks (alternating with occasional ...) consisting of thick sections of limestones, shales, and sandstones were deposited in the Cordilleran Geosyncline (trough) until Cretaceous time (100 million years ago). After this time the area has been mostly out of water and undergoing erosion, faulting and folding as well as volcanic activity.

Several times the sedimentary rocks of the area have been intruded by bodies of molten igneous magma.

The formation of block mountains, with interior basins or valleys, then occurred, and volcanic activity followed the emergence of the land. Later dissection by streams along with regional faulting has left the land as it is today. Thick playa and lake deposits were formed in the enclosed basin areas with salt and gypsum indicating aridity. Crustal movements of considerable magnitude have occurred probably into quaternary times (2-3 million years ago).

Oil and gas, formed under marine conditions, and often deposited in favorable horizons later migrated through suitable channels until trapped by some structural or stratigraphic feature. If subsequent folding and faulting has not caused these oil and gas accumulations to migrate and become lost, they are available to be tapped and utilized.

Eagle Springs Oil Field

Shell Oil Co. drilled the discovery well in the Eagle Springs Oil Field in 1954. In all, Shell drilled four producing wells and two dry holes. From 1961 through 1967 Texota drilled six producing wells and three dry holes extending the producing limits of the field to the east and west. Continental and Western Oil Inc. completed four producing wells bringing to fourteen the number of producing wells in the field.

The subsurface geology of the field is complicated and controversial. The oil appears to have been localized by a trap involving an unconformity, impermeable beds, porosity changes, faulting and possible folding.

Impermeable Quaternary - Tertiary "Valley Fill" unconformably overlies truncated Oligocene and Eocene reservoir rocks. Pay zones are discontinuous laterally and are affected by faulting. To the northeast, producing zones are truncated by a north-northeast trending high angle fault of over 10,000 feet displacement.

The limits of the Eagle Springs Field have been well defined and further extension is not anticipated. Within the field the USGS recognizes the two "Known Geologic Structures".

Stages of Implementation and Related Actions

Exploration

The exploration stage includes all activities from the decision to explore until the "wildcat" well has been drilled. Exploration may be discontinued at any step if acquired data indicate that further activity will have little chance for discovery of oil or gas. Vehicular and human activities are dominant during the exploration stage. Earth moving is confined principally to blading roads and preparation of drill sites. The "wildcat" well and stratigraphic tests involve construction of access roads, drilling pads and sump pits. At the conclusion of an unsuccessful exploration effort, surface restoration is accomplished by capping and/or plugging drill holes and blading and perhaps reseeding of disturbed areas. As exploration progresses from aerial geophysics to the "wildcat" well surface impact varies from negligible to significant.

Exploration for oil and gas involves both geological and geophysical methods.

Geological Exploration

Geological field exploration includes surface and photogeologic mapping and the measurement of stratigraphic sections of exposed rock. Occasionally, where surface geology indicates a structure at depth, a stratigraphic test will be drilled to determine the position and subsurface characteristics of favorably horizons. In the absence of surface structure, a stratigraphic test (strat-test) may be drilled to locate a key bed or to substantiate a structure delineated by geophysical methods. Most geological field work is done on foot utilizing one or more small field vehicles for transportation. Geological exploration, exclusive of the "strat-test", results in little or no impact on the surface.

Geophysical Exploration

Geophysical exploration includes gravity, magnetic, electrical and seismic methods of subsurface evaluation.

Gravity Methods -	The determination of the specific gravity differences of rock masses by mapping the force of gravity of an area using a gravimeter.
Magnetic Method -	A technique of applied geophysics in which a survey is made of local spatial variations in total or vertical magnetic intensity. These measurements recorded on a magneto-meter are interpreted as to depth, size, shape and magnetization of geologic features causing any anomalics disclosed.
Electrical -	The flow of natural telluric currents and magnetic fields is measured and data used to determine structure, often to a considable depth. This is probably the least used of the geophysical methods. The use of induced currents (IP etc.) is restricted to shallow explorations.
Seismic Method -	A type of geophysical investigation based on analysis of elastic waves artifically generated in the earth.

Gravity aerial and magnetic surveys are used in the preliminary evaluation of an area. Surface gravity and seismic methods are utilized for detailed structure determination and target delineation.

Airborne exploration is accomplished by flying a predetermined pattern or grid over an area and utilizing airborne geophysical instruments to gather data that are then compiled and interpreted. In evaluating favorable areas, additional and more detailed data is provided by surface gravity and seismic surveys.

Airborne exploration produces no surface disturbance and creates only a temporary negligible impact on air quality.

Ground gravity surveys are accomplished by a three man crew. Two survey a grid tied to known survey points or landmarks and the third member records gravity readings at predetermined points from a portable gravimeter. The only surface disturbance results from one or two small trucks used to transport the crew and equipment.

Geophysical Exploration

Geophysical exploration includes gravity, magnetic, electrical and seismic methods of subsurface evaluation.

Gravity Methods - The determination of the specific gravity differences of rock masses by mapping the force of gravity of an area using a gravimeter.

Magnetic Method - A technique of applied geophysics in which a survey is made of local spatial variations in total or vertical magnetic intensity. These measurements recorded on a magnetometer are interpreted as to depth, size, shape and magnetization of geologic features causing any anomalies displayed.

Electrical - The flow of natural telluric currents and magnetic fields is measured, and data used to determine structure, often to a considerable depth. This is probably the least used of the geophysical methods. The use of induced currents (AC etc.) is restricted to shallow exploration.

Seismic Method - A type of geophysical investigation based on analysis of elastic waves artificially generated in the earth.

Usually aerial and magnetic surveys are used in the preliminary evaluation of an area. Surface gravity and seismic methods are utilized for detailed structure determination and target evaluation.

Airborne exploration is accomplished by flying a predetermined pattern or grid over an area and utilizing airborne geophysical instruments to gather data that are then compiled and interpreted. In evaluating favorable areas additional and more detailed data is obtained by surface gravity and seismic surveys.

Airborne exploration produces no surface disturbance and creates only a temporary negligible impact on air quality.

Ground gravity surveys are accomplished by a three-man crew. Two survey a grid tied to known survey points or benchmarks and the third records periodic gravity readings at predetermined points from a portable gravimeter. The only surface disturbance results from one or two small trucks used to transport the crew and equipment.

Seismic surveys provide information on subsurface structures by measuring the elapsed time required for induced elastic waves to travel from point of origin back to the surface after being reflected or refracted from strata at depth.

A seismic survey consists of the generation and measurement of elastic waves at predetermined points along a series or grid of straight parallel lines laid out on the surface on an area to be explored. These straight parallel lines are separated by an interval of one to two miles. At each point of wave generation (shot point) a series of receivers (geophones) are laid out on the ground normal to the parallel along which the shot points are positioned. The geophones pick up the surface return of the elastic waves and transmit the impulse by means of connecting cable to a recording truck where the time from generation to surface is computed and plotted.

Elastic waves are generated in the following three ways:

<u>Vibration Method</u> - Vibrations in the earth are produced by a number of truck mounted vibrators, usually four, which vibrate in unison at a frequency controlled by radio from another truck.

<u>Thumping Method</u> - A truck drawn or self-propelled unit containing a heavy weight or "hammer" which is dropped to the ground produces elastic wave propagation in this method.

<u>Explosive Method</u> - In this method a truck-mounted rotary drill is used to drill holes 100-200 feet in depth which are loaded with 5-50 pounds of explosives and detonated (shot) to produce elastic waves.

In all three seismic methods 5-7 trucks and 10-15 men are required. Surface mineral matter and vegetation must be removed from the energy generation sites (shot points) and receiving sites (geophones) to provide for the maximum amount of energy to be sent and received. In addition, the explosive method often requires road construction, blading of lines and clearing of small areas for drill operation.

All three seismic methods involve varying degrees of surface disturbance. The explosive method produces the most intense surface disturbance, and only the explosive method possesses the potential for subsurface impact (damage to nearby water wells, damage to near surface aquifers, etc.).

<u>Drilling</u>

Drilling as defined here includes all drilling operations undertaken during exploration development and production and related operations required for the production of seismic shot-holes, stratigraphic test holes, "wildcat wells" and productions wells.

Drilling rigs used in these operations vary in size from the small truck mounted variety used to drill seismic shot-holes and shallow "strat-tests" to huge oil field rigs weighing many tons and requiring 15-20 trucks to haul the dismantled rig and associated equipment. Depending upon the size of the rig used, the drilling pad which must be prepared, varies in size from a space large enough to accommodate the truck upon which the drill is mounted to an area of 2 1/2 acres for the large wildcat and production rigs.

This type of drilling is known as rotary drilling because it employs the principle of a rotating vertical pipe (drill stem) upon which has been mounted a rock bit designed to chip rock as it rotates under pressure. Drill cuttings or chips produced as the hole progresses are removed from shallow shot-holes by introducing a jet of air during drilling. For deeper drilling a circulating medium of water or mud (a suspension in oil or water of various finely divided substances each possessing specific properties) is pumped down the inside of the drill pipe and allowed to return up the annular space between the hole wall and the outside of the drill pipe. This circulating medium is used to cool and lubricate the bit as well as to return the drill cuttings to the surface. Drilling mud helps prevent cabing by plastering and consolidating the walls of the hole with a clay lining thereby often penetrated which contain fluid, gas or both under extreme pressure. When these situations are encountered, the specific gravity of the drilling mud can be adjusted by adding heavy components in an attempt to equalize the bottom hole pressure and prevent a blowout.

When hydrologic conditions are suitable, the entire hole can often be drilled using air for circulation. Deep air drilling is now possible in a wide variety of rock types and even under rather adverse hydrologic conditions. It has the advantage of not requiring large volumes of water as does mud drilling and is often much faster.

Large oil drilling rigs are provided with mechanical valves known as blow-out preventors which can be closed manually or automatically to prevent blowout or escape of fluids when extreme bottom hole pressures are encountered and mud weight cannot be adjusted quickly enough. Rarely, malfunctions or other unforeseen events allow blowouts and escape of fluid to occur. Blowouts unload the drill pipe from the hole, scatter drilling mud over the surface adjacent to the hole. Blowouts are often accompanied by well fires if the gas is ignited. Well fires usually result in the destruction of the drilling rig, rupture of fuel and storage tanks and general pollution of the surface and air in the vicinity of the well.

Drilling with a circulating fluid requires large quantities of water, as much as 50,000 gallons per day per well during the wildcat and production stages. Smaller amounts are required to drill a stratigraphic test and can be provided by trucks hauling from a source which may be some distance from the test hole. Water requirements for development and production stage wells are, if possible, supplied by water wells drilled in the field. Unless water is obtained from aquifers at sufficient depth, adverse affects may be experienced for operations dependent upon surface water and near surface aquifers.

Drilling rigs used in these operations vary in size from the small truck mounted variety used to drill seismic shot-holes and shallow "strat-tests" to huge oil field rigs weighing many tons and requiring 25-30 trucks to haul the disassembled rig and associated equipment. Depending upon the size of the rig used, the drilling pad which must be prepared, varies in size from a space large enough to accommodate the truck upon which the drill is mounted to an area of 2 1/2 acres for the large wildcat and production rigs.

This type of drilling is known as rotary drilling because it employs the principle of a rotating vertical pipe (drill stem) upon which has been mounted a rock bit designed to chip rock as it rotates under pressure. Drill cuttings or chips produced as the hole progresses are removed from shallow shot-holes by introducing a jet of air during drilling. For deeper drilling a circulating medium of water or mud (a suspension in oil or water of various finely divided substances each possessing specific properties), is pumped down the inside of the drill pipe and allowed to return up the annular space between the hole wall and the outside of the drill pipe. This circulating medium is used to cool and lubricate the bit as well as to carry the drill cuttings to the surface. Drilling mud helps prevent caving by plastering and consolidating the walls of the hole with a clay film thereby sealing formations penetrated which contain fluid, gas or both under extreme pressure. When these situations are encountered, the specific gravity of the drilling mud can be adjusted by adding heavy components to it in an attempt to equalize the bottom hole pressure and prevent a blowout.

When hydrologic conditions are favorable, the entire hole can often be drilled using air for circulation. Deep air drilling is now possible in a wide variety of rock types and even under certain adverse hydrologic conditions. It has the advantage of not requiring large amounts of water as does mud drilling and is often much faster.

Large oil drilling rigs are provided with mechanical valves known as blowout preventers which can be closed manually or automatically to prevent blowout or escape of fluids when extreme bottom hole pressures are encountered and mud weight cannot be adjusted quickly enough. Sudden, malfunction or other unforeseen events allow blowouts and escape of fluid to occur. Blowouts unload the drill pipe from the hole, scatter drilling mud over the surface adjacent to the hole. Blowouts are often accompanied by well fires if the gas is ignited. Well fires usually result in the destruction of the drilling rig, rupture of fuel and storage tanks and general pollution of the surface and air in the vicinity of the well.

Drilling with a circulating fluid requires large quantities of water, as much as 20,000 gallons per day per well during the wildcat and production stages. Smaller amounts are required to drill a stratigraphic test and can be provided by trucks hauling from a source which may be some distance from the test hole. Water requirements for development and production stage wells are, if possible, supplied by water wells drilled in the field. Unless water is obtained from aquifers at sufficient depth, adverse effects may be experienced for operations dependent upon surface water and near surface aquifers.

Development

This stage of implementation is the period of most intense activity. The producing limits of the field are outlined by developmental drilling and production wells are spaced in a manner to most efficiently exploit the field. During this period many mud pits and other earth filled impoundments are required for mud handling during drilling, and for entrapment of fluids including oil which may escape during drilling and testing. Human and vehicular activity are high during this time. As the field develops, these structures are gradually replaced by tanks and structures of a more permanent and reliable nature. This is the period of construction of pump stations, flowlines, pipelines and electrical transmission lines. Because of the number of wells being drilled at this time accidental spills, leaks, blowouts and fires can occur more frequently and have the greatest impact on the surface during this stage of implementation.

Production

The production stage is principally the operation and maintenance interval. Oil which flows or is pumped from wells is collected and transported by pipeline or truck to a refinery. Old wells are often deepened, or otherwise "worked over", in an attempt to intercept new pay zones. Secondary recovery methods utilizing injection of water or gas into peripheral wells to obtain oil otherwise not recoverable are initiated during this stage. Collection facilities, pipelines and transmission lines have been constructed by this time. Methods of solid and liquid waste disposal have been standardized. The impact on surface and air from construction, spills, accidents and human activity are proportionately less than during the developmental stage.

Abandonment

Equipment removal, cementation and capping of drill holes and wells, rehabilitation and revegetation of the surface are accomplished during this stage of implementation. During this stage adverse surface impacts will be at a minimum. Rehabilitation and revegetation will produce beneficial surface impact.

Rights and Obligations of Lessee

The standard lease (Form 3120-3) grants certain rights to, and imposes certain obligations upon, the lessee.

Section 1 of the standard lease grants to the lessee "the exclusive right and privilege to drill for, mine, extract, remove and dispose of all the oil and gas deposits except helium gas, in the lands leased, together with the right to construct and maintain thereupon, all works, buildings, plants, waterways, roads, telegraph or telephone lines, pipelines, reservoirs, tanks, pumping stations, or other structures necessary to the full enjoyment thereof, for a period of 10 years, and so long thereafter as oil and gas is produced in paying quantities".

Section 2(q) of the standard lease imposes upon the lessee a number of standard stipulations designed to protect the surface, natural resources and improvements.

The stipulations require the lessee "to take such reasonable steps as may be needed to prevent operations from unnecessarily:

1. Causing or contributing to soil erosion or damaging any forage and timber growth thereon,

2. polluting the waters of reservoirs, springs, wells, or streams,

3. damaging crops, including forage, timber, or improvements of a surface owner, or

4. damaging range improvements whether owned by the United States or by its grazing permittees or lessees; and upon conclusion of operations, so far as can reasonably be done, to restore the surface to its former condition."

The lessor may prescribe the steps to be taken and restoration to be made with respect to the lands of the United States and improvements thereon."

In addition to the standard stipulations set forth in Section 2(q) of the lease (Form 3120-3), a copy of the following Oil and Gas - Surface Disturbance Stipulations, more commonly referred to as the "Open-End Stipulation" is attached to the lease:

1. Notwithstanding any provision of this lease to the contrary, any drilling, construction or other operation on the leased lands that will disturb the surface thereof or otherwise affect the environment (hereinafter called "surface disturbing operation") conducted by lessee shall be subject, as set forth in this stipulation, to the prior approval of such operation by the Area Oil and Gas Supervisor in consultation with the appropriate surface management agency and to such reasonable conditions, not inconsistent with the purposes for which this lease is issued, as the Supervisor may require to protect the surface of the leased lands and the environment.

2. Prior to entry upon the land or the disturbance of the surface thereof for drilling or other purposes, the lessee shall submit for approval two copies of a map and explanation of the nature of the anticipated activity and surface disturbance to the Area Oil and Gas Supervisor, (address) and will also furnish the appropriate surface management agency (name and address) with a copy of such map and explanation.

   An environmental analysis will be made by the Geological Survey in consultation with the appropriate surface management agency for the purpose of insuring proper protection of the surface,

the natural resources, the environment, existing improvements, and for assuring timely reclamation of disturbed lands.

3. Upon completion of said environmental analysis, the Area Oil and Gas Supervisor shall notify lessee of the conditions, if any, to which the proposed surface disturbing operations will be subject.

Said conditions may relate to any of the following:

1. The location of drilling or other exploratory or developmental operations or the manner in which they are to be conducted;

2. Tye types of vehicles that may be used and the areas in which they may be used; and

3. The manner of location in which improvements such as roads, buildings, pipelines or other improvements are to be constructed.

Standard stipulations incorporated in the lease provide broad general protection to the environment by requiring reasonable steps be taken to prevent unnecessary soil erosion, water pollution and damage to crops, forage, timber and range improvements as well as providing that the lessor (BLM) can prescribe steps to be taken and restoration to be accomplished.

These stipulations adequately provide surface protection except for critical areas and special conditions. In general, they are adequate for the exploration stage of implementation.

At the point in time when the lessee anticipates initiating operations such as drilling and construction which will disturb the surface or otherwise affect the environment, the provisions of the "Open-End Stipulation" become operative. Before any surface disturbance is permitted the USGS must make an environmental analysis and in conjunction with the BLM provide additional or special stipulations deemed necessary for the protection of the surface, the natural resources, the environment, existing improvements and for assuring timely reclamation of disturbed lands.

When a site has been selected to drill, the focus of environmental impacts will shift from the total area of the lease to an area roughly 2 1/2 acres in size. Special stipulations designed specifically to mitigate environmental impacts produced by drilling activities in a discrete area can be formulated at this time.

Leasing Considerations

In developing the environmental analysis record prior to leasing, surface environmental impacts resulting from the proposed action and alternatives are analyzed and special stipulations formulated to mitigate these impacts.

the natural resources, the environment, existing improvements, and for assuring timely reclamation of disturbed lands.

2. Upon completion of said environmental analysis, the Area Oil and Gas Supervisor shall notify lessee of the conditions, if any, to which the proposed surface disturbing operations will be subject.

ial conditions may relate to any of the following:

1. The location of drilling or other exploratory or development operations or the manner in which they are to be conducted;

2. The types of vehicles that may be used and the areas in which they may be used; and

3. The manner or location in which improvements such as roads, buildings, pipelines, or other improvements are to be constructed.

Standard stipulations incorporated in the lease provide broad general protection to the environment by requiring reasonable precautions taken to prevent unnecessary soil erosion, water pollution and damage to crops, forage, timber and range improvements as well as providing that the lessor (BLM) can prescribe steps to be taken and restoration to be accomplished.

These stipulations adequately provide surface protection except for critical areas and special conditions. In general, they are adequate for the lease sale stage of implementation.

At the point in time when the lessee anticipates initiating operations such as drilling and construction which will disturb the surface or otherwise affect the environment, the provisions of the "Supp-200 stipulation" become operative. Before any surface disturbance is permitted the USGS must make an environmental analysis and in conjunction with the BLM prescribe additional or special stipulations deemed necessary for the protection of the surface, the natural resources, the environment, existing improvements, and for assuring timely reclamation of disturbed lands.

When a site has been selected to drill, the scope of environmental impact will shift from the total area of the lease to an area roughly 4-5 acres in size. Special stipulations designed specifically to mitigate environmental impacts produced by drilling activities on a discrete area can be formulated at this time.

Specific Considerations

In developing the environmental analysis record, the probable adverse environmental impacts resulting from the proposed action and alternatives are analyzed and special stipulations formulated to mitigate those impacts

When issued, a lease grants certain rights to the lessee. Special stipulations which deny or infringe the rights granted by a lease should be included at the time the lease is issued. If conditions exist such that an environmental impact can be mitigated only be formulation of stipulations in conflict with a lease granted right, the lessee should be aware of such conflicts in order that he may elect not to lease if the conflicting stipulations create an untenable situation for him.

An example of such a stipulation is one in which the lessee is denied the right to surface occupation of the leased land except by decision of the BLM District Manager concerned. Another stipulation might be formulated to exclude surface occupation of certain areas in a lease and to allow only directional (angle) drilling to explore beneath these areas.

Such stipulations limit the lease granted rights of a lessee and might influence his decision whether or not to lease.

BIBLIOGRAPHY

1. Albers, J.P., and Stewart, 1972. Geology & Mineral Deposits of Esmeralda Co., Nev., Bul. 78, Nev. Bur. Mines & Geol..

2. Cornwall, H.R., 1972. Geology & Mineral Deposits of So. Nye Co., Nev., Bul. 77, Nev. Bur. of Mines & Geol..

3. Eng. Mining Journal, April, 1974. The Quest for U.S. Energy Sufficiency.

4. Fellows, R.D., et al, 1974. Economic Profile Supplement, Las Vegas District, BLM.

5. Malmberg, G.T., & Eakin, T.E., 1962. Ground-water Resources Report 10, Appraisal of Sarcobatus Flat & Oasis Valley, Nye & Esmeralda Co. Nev. USGS.

6. Mason, H.G., 1950. Prelim. Report on Ground Water in Fish Lake Valley, Nev. & Calif. USGS Water Res. Bul. No. 11.

7. Mayo, E., 1968. Mineral Resource Analysis of the Goldfield Planning Unit in the Esmeralda Resource Area, BLM Report.

8. Myers. L.H., 1970. Habitat Management Plan-Silver Peak Range, N5-WHA, T33, BLM Report.

9. Rush, E.R., 1968. Water Resources Report 45, Appraisal of Clayton Valley-Stonewall Flat Area, Nev. & Calif., USGS.

10. State Eng. Office, 1971. Water for Nevada, Hydrologic Atlas of Nev.

11. Van Denburgh, A.S., & Glancy, P.A., 1970. Water Resource Report 52, Appraisal of the Columbus Salt Marsh--Soda Spring Valley Area, Mineral & Esmeralda Co., Nev., USGS.

12. Walker, G.E., & Eakin, T.E., 1963. Ground-water Resources Report 14, Geology & Groundwater of Amargosa Desert, Nev. & Calif., USGS.

he anatomy of an oil well

The average drill hole is going deeper and deeper to find l. In 1969 the average US well was 4,881 ft deep, although fshore wells were about twice the average. Down to 4,000 ft so, truck-mounted rigs can handle the drilling. Beyond this pth, much larger semi-stationary rotaries must be erected at e site. Today it is not uncommon to drill to depths well beond 20,000 ft onshore, which requires an elaborate mud cirlation, ponding, and mud settling system.

Drilling costs are directly related to time. An onshore shalw hole may run $4,000 in daily expenses, while an offshore in the North Sea may siphon off $35,000 per day. Well acing is generally a function of depth. An industry norm is e well per 20 acres for a 2,000-ft-deep reservoir, one per 40 res for a 4,000-ft reservoir, and one per 80 acres for holes ing down to 12,000 ft deep.

Drilling starts with a large conductor hole, 30 to 200 ft ep, depending on ground conditions. For a well going to 000 ft deep, the collar may be cased with 8⅝-in.-dia steel, outed in the hole, and followed with 5½-in. casing as the le progresses to its targeted depth. A well destined to tap a ,000-ft-deep reservoir may be cased with 13⅜-in. steel at e collar section, then lined with 8⅝-in.-dia steel, and finhed off with 5½-in. casing. All lining is cemented in place.

A blowout preventer is installed at the top of the well. If e drill bit cuts a high pressure zone and the drill mud mix, ntaining a barite suspension, fails to contain the pressure, a stem of valves can be shut off to control the well. The drill s may be diamond impregnated, or set with tungsten carde buttons on roller cones, or may contain hardened steelothed tips on roller cones. The choice depends on the forution hardness, the rate of penetration, the degree of mple inspection desired, and the rate of bit wear, which imcts directly on lost time for drill string pull-out and run-in r bit changes.

As the hole progresses, well logging instruments measure e natural electrical potential or the resistance to induced tential of the surrounding rock, or its reaction to gamma y bombardment or high frequency sonics. Cuttings separed from the mud suspension are examined microscopicy. The accumulated evidence is continually evaluated ainst drilling costs and estimated productivity return to determine whether to continue or abandon the hole. When a servoir is reached, drill stem tests are run to determine the own hole pressure.

A hole finished to a producing horizon is sealed with outed casing which must be perforated. This is done by eans of shaped charges which blow small holes in the steel sing and annular cement ring. To improve permeability and flow of liquids and gas from the formation, it may be necessary to fracture it with a fluid-sand suspension forced into the hole at pressures up to 20,000 psi. Under such pressure, cracks radiating from the well bore may extend outward to 100 ft or more. Acidizing can also improve permeability, as acid solution pumped down the hole reacts with carbonate rock to increase porosity.

The final step in developing the well is to run a 2-in. to 4-in. string of tubing down the hole to the reservoir and cap it on the surface with a "Christmas tree"—a system of pipes and valves which controls the flow of oil and gas from the well.

Unless the well is a high volume producer (allowing oil to be piped directly from the well site), a tank battery and gathering system must be installed to collect and separate water, oil, and gases. The hydrocarbons are stored for truck pickup. For wells which need a mechanical lift, three types are generally used at onshore sites in the US. Rod pumps are used quite widely down to 8,000 ft in most areas except the Gulf Coast. Hydraulic units are used for wells to 12,000 ft. The gas lift is used in areas where gas is plentiful and where a large volume of total fluid must be lifted to the surface.

The annual output from existing producing wells in the oil and natural gas industry is destined to decline as formation pressure is released. The operating cost of a 4,000-ft well in the US may approximate 60-80¢ a bbl during the first year or two of production. For a well which has an annual rate of decline in productivity of 30%, costs may climb to $2.38 a bbl during the 13th year of its life. If the rate of decline is only 15% a year, the operating costs may rise to 91¢ a bbl in the 11th year of its life, but costs then go up at an accelerating rate to about $2.40 in the 24th year.

While these operating costs are purely hypothetical, they are based on a 1973 profitability analysis of developing and producing crude oil and natural gas liquids by primary methods from selected domestic onshore areas, conducted by the US Bureau of Mines (IC 8561—"Engineering Cost Study of Development Wells and Profitability Analysis of Crude Oil Production"). The example, however, illustrates how production of oil must be massaged by managed well spacing and flow rate controls to achieve optimum producibility and recovery. Drawing on reserves at an uncontrolled rate can ruin or seriously deplete an oil field.

On balance, only 10% to 12% of known reservoirs can be recovered with the assistance of natural pressures and pumping. Secondary recovery, such as water flooding, acidizing, and hydrofracturing, may boost this figure to a little over 40%. Tertiary recovery methods, such as the use of detergents or surfactants, or even in-situ combustion, may provide a further small recovery, but these methods are expensive. Such techniques, however, are worth investigating.

atural gas: clean and too cheap

Many of the conditions which are significant for development of oil apply to natural gas as well. To a large extent, natal gas and oil are often found in the same or similar straraphic traps. Many of the natural gas fields have been scovered in the search for oil. Natural gas associated with l was formerly allowed to escape under carefully controlled nditions because it contributed to the pressure for lifting oil the surface. Before the development of natural gas pipees, the gas which was drawn off was vented to the atmohere or flared. This, in turn, has led to some uncertainties in timating potential and undiscovered natural gas resources, cause for many years no records were kept of the gas-to-oil tio of wasted gas associated with crude oil production. Curntly, about 25% of the proved natural gas reserves are assoated with oil field sources in the US.

In one respect natural gas differs from oil. It will escape from a well without artificial stimulants except in very old fields, where the pipeline pressure may exceed well pressure. In this instance, pumping must be used.

Methane generally makes up 80% by volume of natural gas as it comes to the surface. The heavier hydrocarbons of the natural gas mix condense more easily. One heavy hydrocarbon that liquefies at normal pressure and temperature is known as natural gasoline. It is often mixed with oil refinery gasoline as a motor fuel. A lighter fraction can be stripped at higher pressure and temperature as a source of butane and propane. As a practical matter, however, only about 10% of the natural gas liquids (NGL) are stripped from natural gas to yield the so-called "dry gas." The big future for natural gas lies in drilling below 15,000 ft—a very expensive proposition.

XII. APPENDIX

Unique Geographical Areas*

Certain National Resource Lands within the Caliente and Virgin Valley Planning Units have been identified as having values which preclude leasing activities of any kind. They are included within the following descriptions:

1 South Pahroc Range (Proposed Primitive Area) - See Map #2

T. 4 S., R. 61 E., Sec. 36
T. 4 S., R. 62 E., Sec. 14, 15, 21-23, 26-35
T. 5 S., R. 61 E., Sec. 1, 12
T. 5 S., R. 62 E., Sec. 2-11, 14-18, 20-22, 27-29, 32-34
T. 6 S., R. 62 E., Sec. 3-5, 8-10, 14-17, 23

2. Arrow Canyon (Proposed Primitive Area) - Map #1C

T. 13 S., R. 63 E., Sec. 24, 36
T. 14 S., R. 63 E., Sec. 1, 12, 13, 23, 24, 35, 36
T. 15 S., R. 63 E., Sec. 1, ?, 11-14, 22-25, 35, 36
T. 16 S., R. 63 E., Sec. 1, 2, 11-14
T. 14 S., R. 64 E., Sec. 3-10, 14-24, 26-36
T. 15 S., R. 64 E., Sec. 1-15, 23, 24
T. 14 S., R. 65 E., Sec. 17, 18

3. Virgin Mountain (Proposed Primitive Area, crucial peregrine falcon habitat) - Map #1A

T. 15 S., R. 70 E., Sec. 12-14, 22-28, 34-36
T. 16 S., R. 70 E., Sec. 1-3, 10-12
T. 15 S., R. 71 E., Sec. 6, 7, 15-22, 27-30, 33, 34
T. 16 S., R. 71 E., Sec. 3, 4, 9, 10, 15, 16

4. Flat Top Mesa (Unique Geologic Area) - Map #1A

T. 12 S., R. 70 E., Sec. 26, 34, 35
T. 13 S., R. 70 E., Sec. 2, 3, 10, 11, 14-16, 21, 22, 27, 28

5. Moapa Area (Endangered Fish Habitat) - Map #1D

T. 14 S., R. 65 E., Sec. 8-11, 16-17, 21, 22

6. Ash Springs (Protected Fish Habitat) - Map #2

T. 6 S., R. 60 E., Sec. 1
T. 6 S., R. 61 E., Sec. 6

*exclude any private lands within the given legal descriptions.

The following lands within the area covered by this EAR contain resources with values that need special protective stipulations or perhaps even need to be closed completely to all leasing activities of oil, gas and geothermal resources. While both URA & MFP studies on these lands have been completed, the complexity of the situations are such that a site-by-site appraisal (of prospecting permits, notice of intent to conduct geothermal resource exploration operations, and lease applications) will be necessary prior to authorizing exploration/leasing. Affected are National Resource Lands within the following:

1. Highland Range (Bristlecone Pine Botanical Area) - See Map #2

   T. 1 N., R. 66 E., Sec. 13-36
   T. 1 S., R. 66 E., Sec. 1-4, 9-16, 22-27

2. Delamar (Joshua Tree Botanical Area) - Map #2

   T. 4 S., R. 64 E., Sec. 10-15, 22-27, 34-36
   T. 4 S., R. 65 E., Sec. 7, 18, 19, 30, 31
   T. 5 S., R. 64 E., Sec. 1, 2, 10-15, 22-27, 34-37
   T. 6 S., R. 64 E., Sec. 1-3, 10-12

3. Delamar Mountains (Wildlife Habitat Area) - Map #2

   T. 5 S., R. 65 E., ALL
   T. 5 S., R. 66 E., Sec. 5-8, 17-20, 29-32
   T. 6 S., R. 65 E., ALL
   T. 6 S., R. 66 E., Sec. 5-8, 17-20, 29-32
   T. 7 S., R. 65 E., ALL
   T. 7 S., R. 66 E., Sec. 5-8, 17, 18 35, 36
   T. 7 S., R. 67 E., Sec. 31, 32
   T. 8 S., R. 64 E., ALL

4. Muddy Mountains - Map #1B

   T. 18 S., R. 65 E., Sec. 13, 24, 25
   T. 17 S., R. 66 E., Sec. 31, 32
   T. 18 S., R. 66 E., Sec. 4-19, 22-24, 30
   T. 18 S., R. 66½ E., Sec. 6, 7, 18, 19, 30, 31
   T. 18 S., R. 67 E., Sec. 2-11, 16-18, 21, 22, 27-29, 31 32
   T. 19 S., R. 66½ E., Sec. 6, 7
   T. 19 S., R. 67 E., Sec. 5, 6

5. Virgin River Recreation Lands - Map #1D
   Portions of:

   T. 13 S., R. 70 E., Sec. 27, 32-34
   T. 14 S., R. 69 E., Sec. 14, 15, 22, 27-29, 32
   T. 14 S., R. 70 E., Sec, 4-8
   (see paragraph 6 of N-1575A Serial Register dated September 25, 1970, and Federal Register Vol. 35 No. 187 for a full description of these lands).

6. Meadow Valley Mountains (Important Bighorn Yearlong Habitat) Map #2

T. 8 S., R. 66 E., Sec. 1, 2, 10-16, 21, 22-24, 32, 33
T. 9 S., R. 65 E., Sec. 1, 12, 13, 23-26, 35, 36
T. 10 S., R. 64 E., Sec. 23-26, 35, 36
T. 10 S., R. 65 E., Sec. 2, 3, 10-12, 15, 21, 22, 28-33

7. Mormon Peak (Proposed Roadless Area) - Map #2

T. 10 S., R. 67 E., Sec. 13-16, 20-29, 32-36
T. 10 S., R. 68 E., Sec. 7-10, 14-36
T. 11 S., R. 67 E., Sec. 1-6, 9-12
T. 11 S., R. 68 E., Sec. 1-12

8. Mormon Peak (Crucial Bighorn Summer Habitat and Roadless Area)

T. 11 S., R. 67 E., Sec. 1-3, 9-12, 13-17, 20-24, 25-27, 35, 36
T. 11 S., R. 68 E., Sec. 31-32
T. 12 S., R. 67 E., Sec. 1
T. 12 S., R. 68 E., Sec. 5-9

9. Meadow Valley Mountains (Proposed Roadless Area) - Map #2

T. 7 S., R. 66 E., Sec. 25, 35, 36
T. 7 S., R. 67 E., Sec. 19, 29-33
T. 8 S., R. 66 E., Sec. 1-3, 9-17, 20-29, 32-36
T. 8 S., R. 67 E., Sec. 3-10, 15-22, 28-33
T. 9 S., R. 65 E., Sec. 1, 11-14, 23-25, 33-36
T. 9 S., R. 66 E., Sec. ALL
T. 9 S., R. 67 E., Sec. 4-9, 16-21, 28-33
T. 10 S., R. 64 E., Sec. 13, 14, 22-27, 33-36
T. 10 S., R. 65 E., Sec. ALL
T. 10 S., R. 66 E., Sec. 1-22, 28-32
T. 10 S., R. 67 E., Sec. 5-7
T. 11 S., R. 64 E., Sec. 1-4, 12-15, 23, 24
T. 11 S., R. 65 E., Sec. 1-21
T. 11 S., R. 66 E., Sec. 5-8

10. Clover Mountains (Proposed Roadless Area) - Map #2

T. 6 S., R. 67 E., Sec. 5-9, 13-36
T. 6 S., R. 68 E., Sec. 19-21, 26-36
T. 6 S., R. 69 E., Sec. 31, 32, 35, 36
T. 6 S., R. 70 E., Sec. 29-34
T. 7 S., R. 67 E., Sec. 1-5, 8-16, 22-25, 36
T. 7 S., R. 68 E., Sec. 1-20, 23-27, 30-31, 34-36
T. 7 S., R. 69 E., ALL
T. 7 S., R. 70 E., Sec. 3-10, 15-22, 27-33
T. 8 S., R. 68 E., Sec. 1, 2, 11-14, 24, 25
T. 8 S., R. 69 E., Sec. 2-11, 14-22, 29-32

11. Cedar Range/Clover Mts. (Crucial Deer Habitat) - Map #2

T. 3 S., R. 68 E., Sec. 25, 36
T. 3 S., R. 69 E., Sec. 30, 31
T. 4 S., R. 68 E., Sec. 1
T. 4 S., R. 69 E., Sec. 6, 7
T. 4 S., R. 70 E., Sec. 23-26, 36
T. 4 S., R. 71 E., Sec 19, 30
T. 5 S., R. 71 E., (Nevada, exclude State Parks Lands)
T. 5 S., R. 67 E., Sec. 14-17, 20-29, 33-36
T. 6 S., R. 70 E., Sec. 1, 11-16, 21-28, 33-36
T. 6 S., R. 71 E., Sec. 4-9, 16-21, 28-30, 31-33

12. Clover Creek (Upland Game/Waterfowl Habitat) - Map #2

T. 4 S., R. 68 E., Sec. 27, 34, 35
T. 5 S., R. 68 E., Sec. 1, 11, 12

The following lands are identified specifically as expansion areas for units of the Nevada State Park System to be acquired under the Recreation and Public Purposes Act). Prior to authorizing oil , gas and geothermal exploration/leasing in these areas, formal contact should be made with the Administrator, Nevada State Park System.

1. Beaver Dam State Park Area:
T. 1 S., R. 68 E., Sec. 19

2. Echo Canyon State Recreation Area:
T. 1 N., R. 69 E., Sec. 29

3. Kershaw-Ryan State Recreation Area:
T. 4 S., R. 67 E., Sec. 18, 19

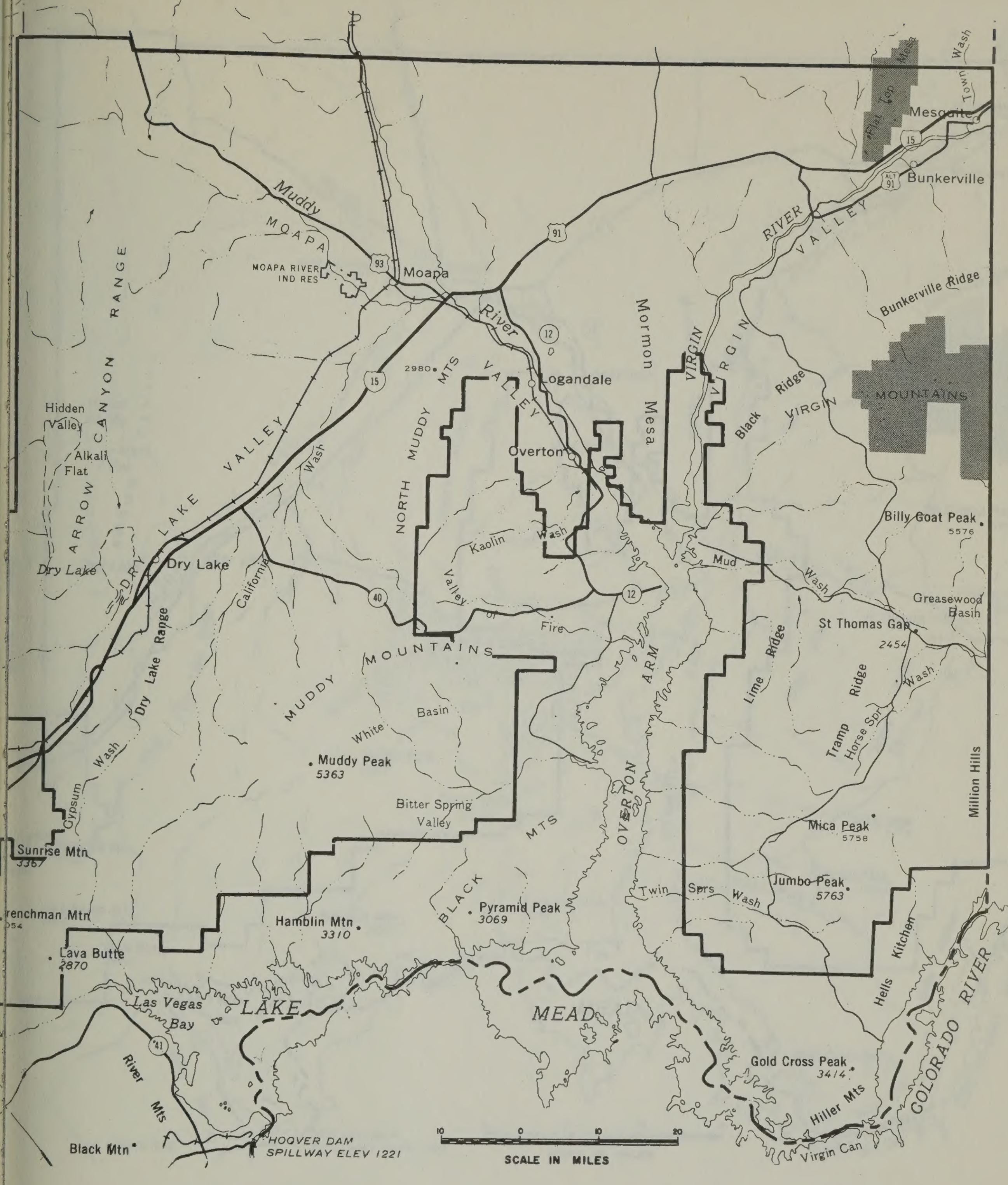
4. Cathedral Gorge State Park:
T. 5 S., R. 71 E., Sec. 4, 5, 7-9, 18, 20, 21

5. Valley of Fire State Park:

T. 16 S., R. 66 E., Sec. 12, 13, 24
T. 17 S., R. 66 E., Sec. 11-14, 23-26
T. 15 S., R. 67 E., Sec. 31-33
T. 16 S., R. 67 E., Sec. 4-9, 16-21, 28, 29
T. 17 S., R. 67 E., Sec. 32

Finally, no surface occupancy should be allowed on the following rights-of-way and their accompanying material deposits:

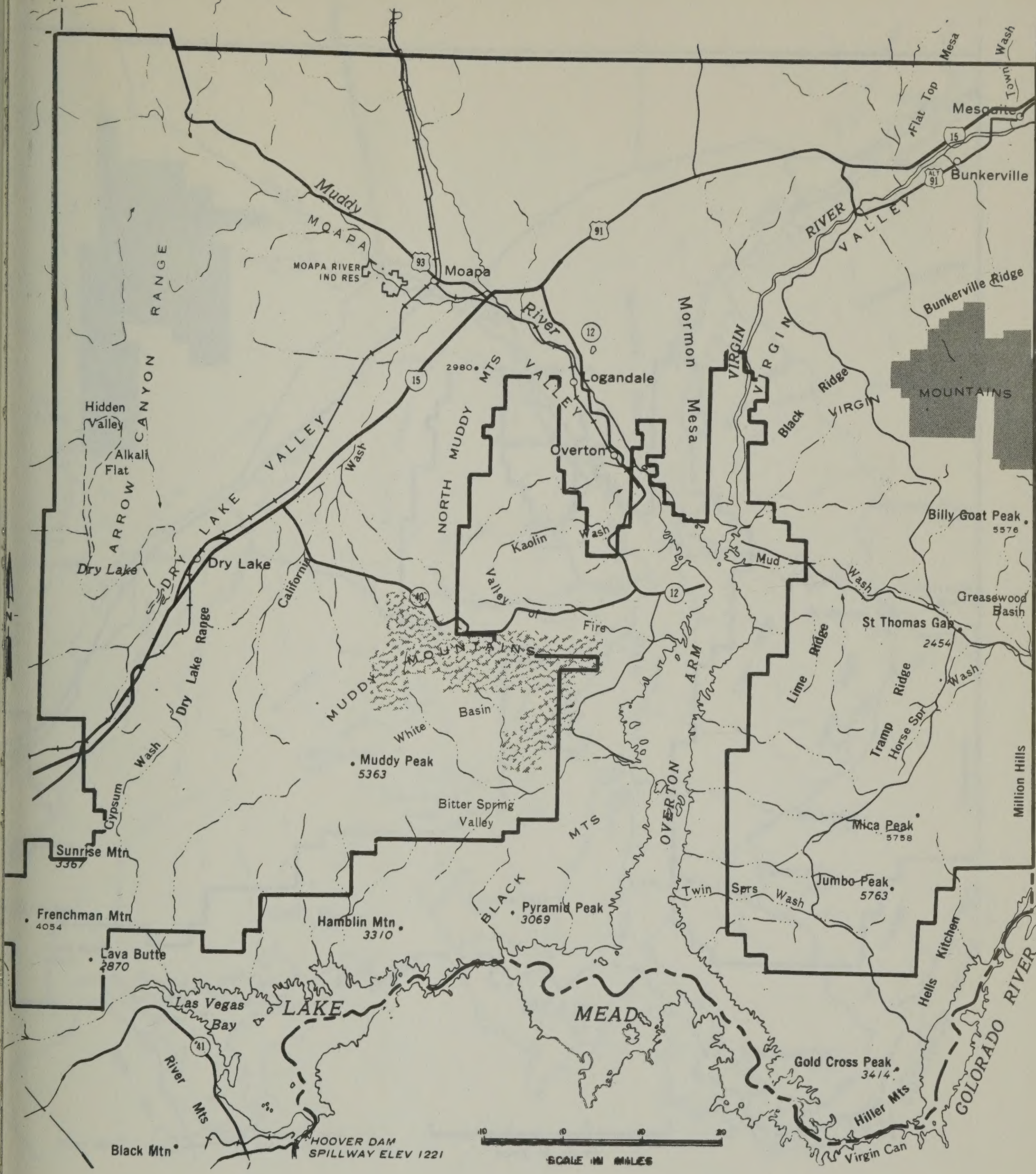
I-15	SR 25	SR 86
US 93	SR 40	
SR 7	SR 54	
SR 12	SR 85	



NO LEASING (RECREATIONAL VALUES)

UNIQUE GEOLOGICAL AREAS
Virgin Valley Planning Unit

MAP #1A

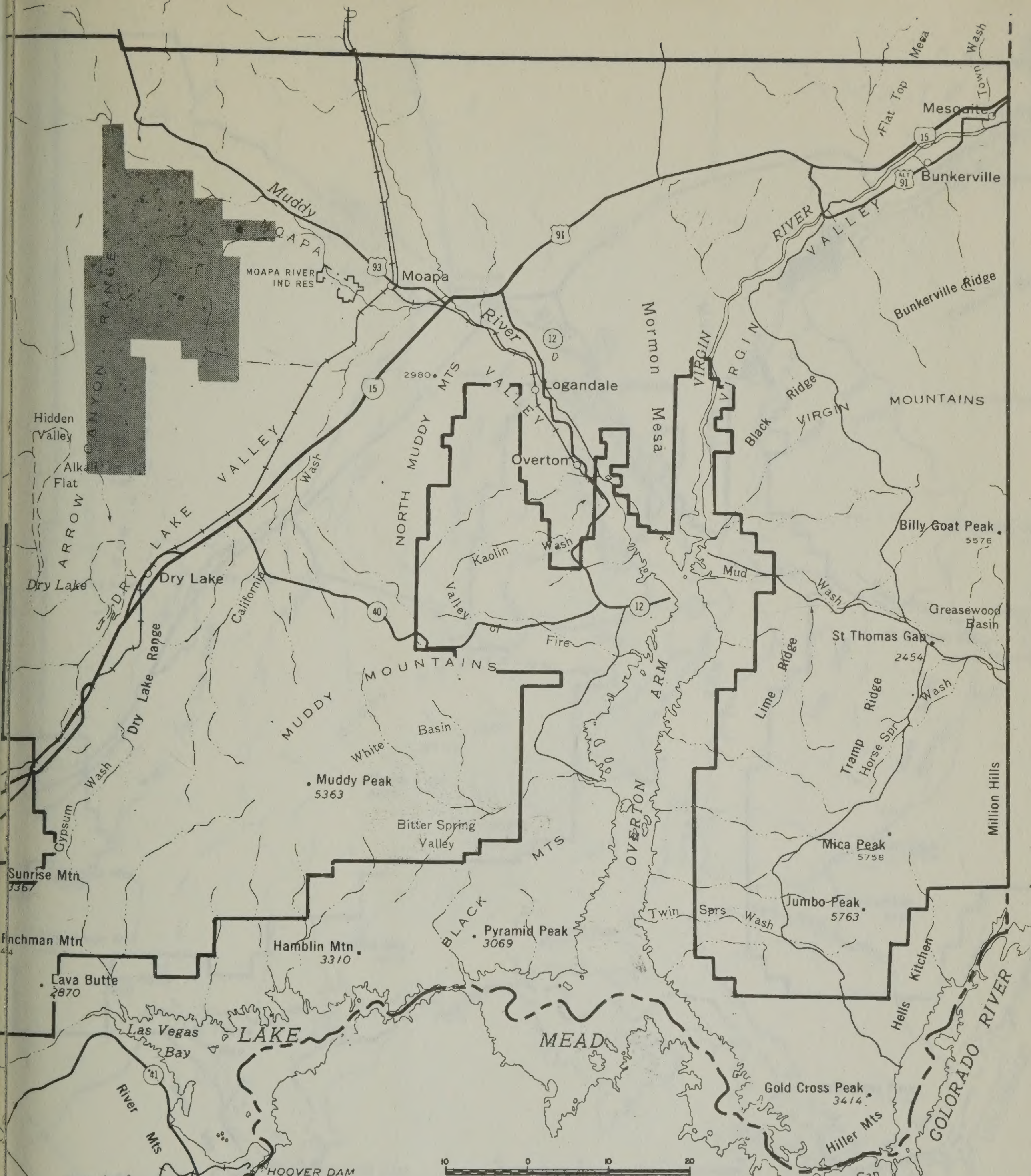


NO LEASING (RECREATIONAL AND WILDLIFE VALUES)

SITE-BY-SITE APPRAISAL

UNIQUE GEOLOGICAL AREAS
Virgin Valley Planning Unit

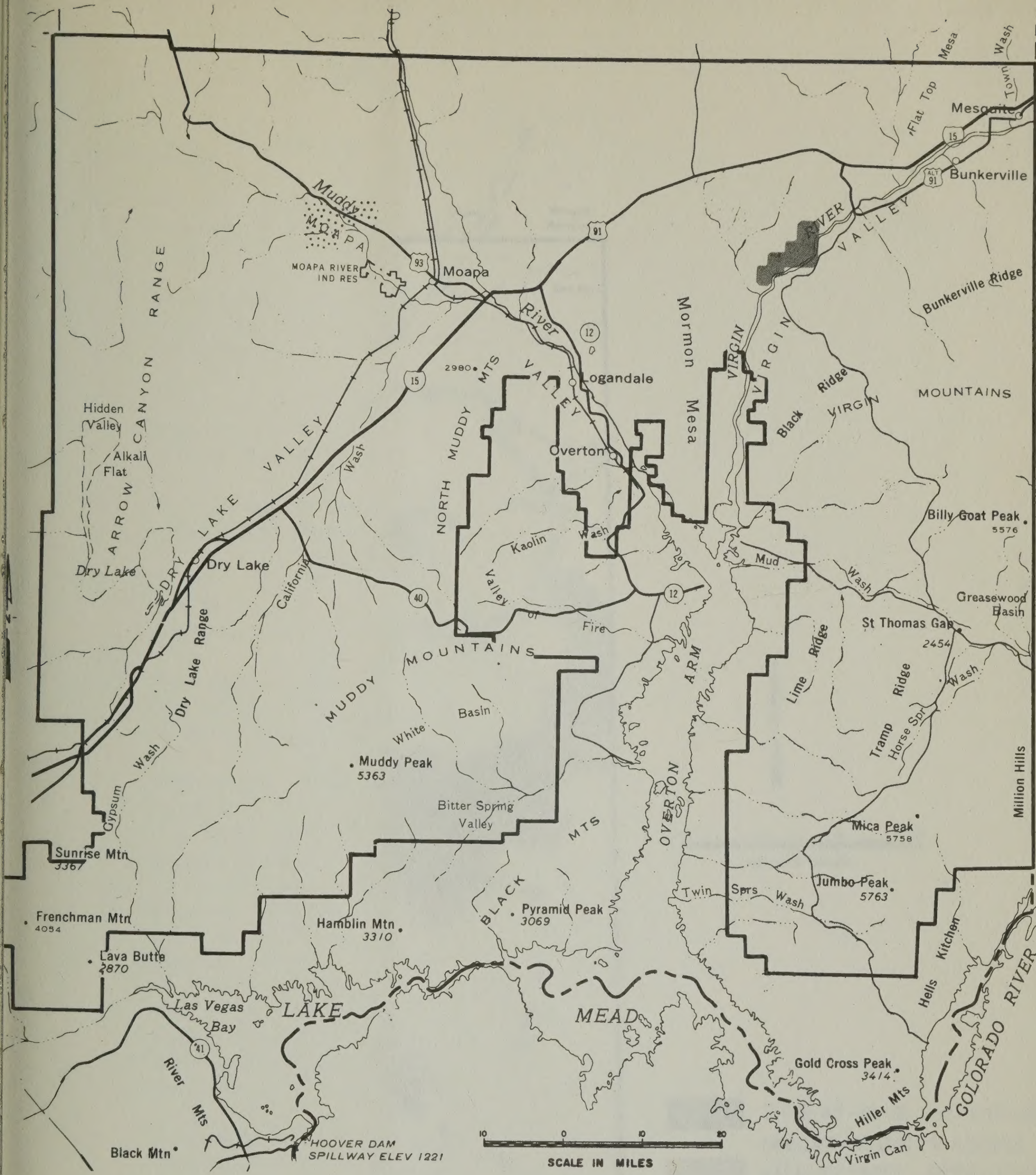
MAP #1B



NO LEASING (RECREATIONAL AND WILDLIFE VALUES)

UNIQUE GEOLOGICAL AREAS
Virgin Valley Planning Unit

MAP #1C



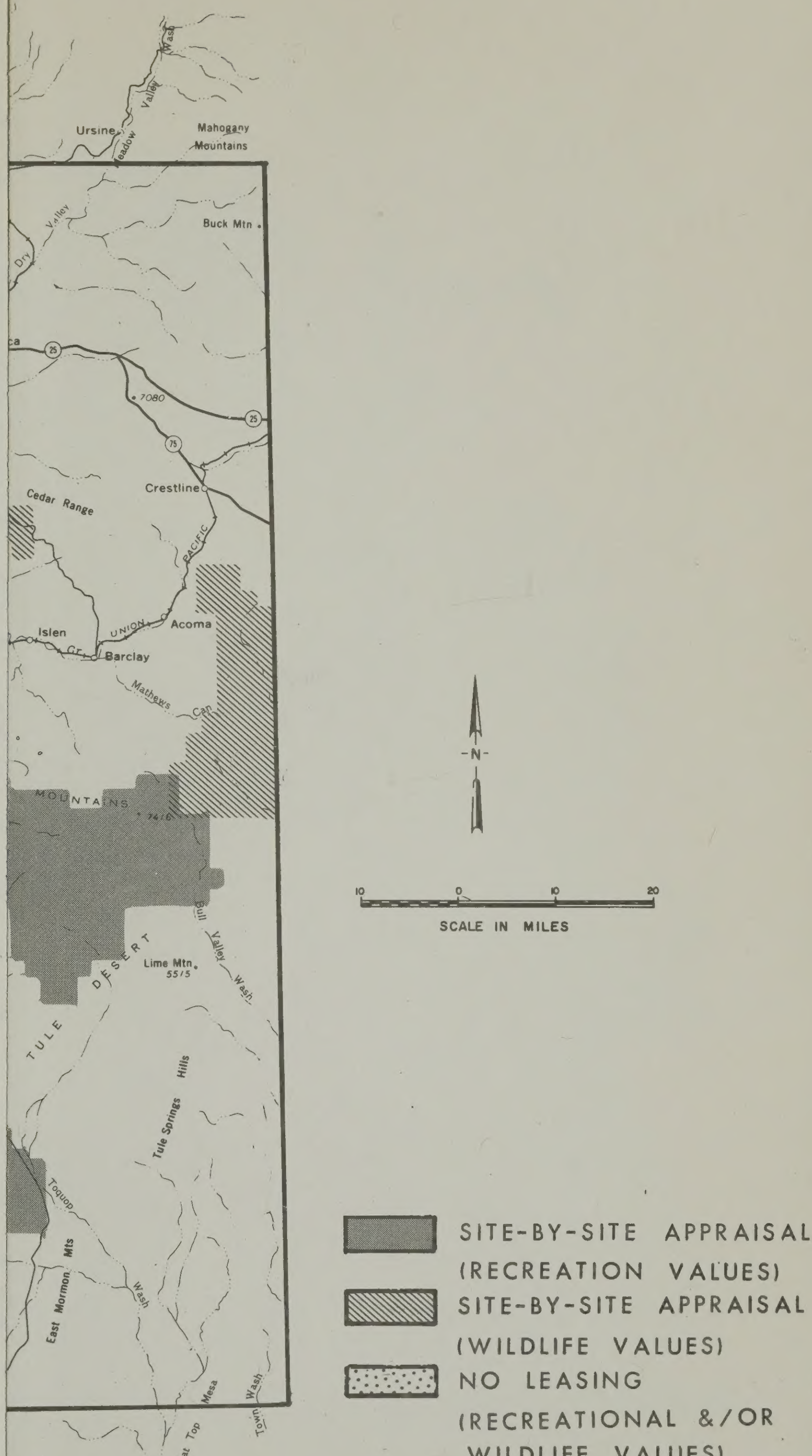
NO LEASING (WILDLIFE VALUES)

SITE-BY-SITE APPRAISAL NEEDED (RECREATIONAL AND WILDLIFE VALUES)

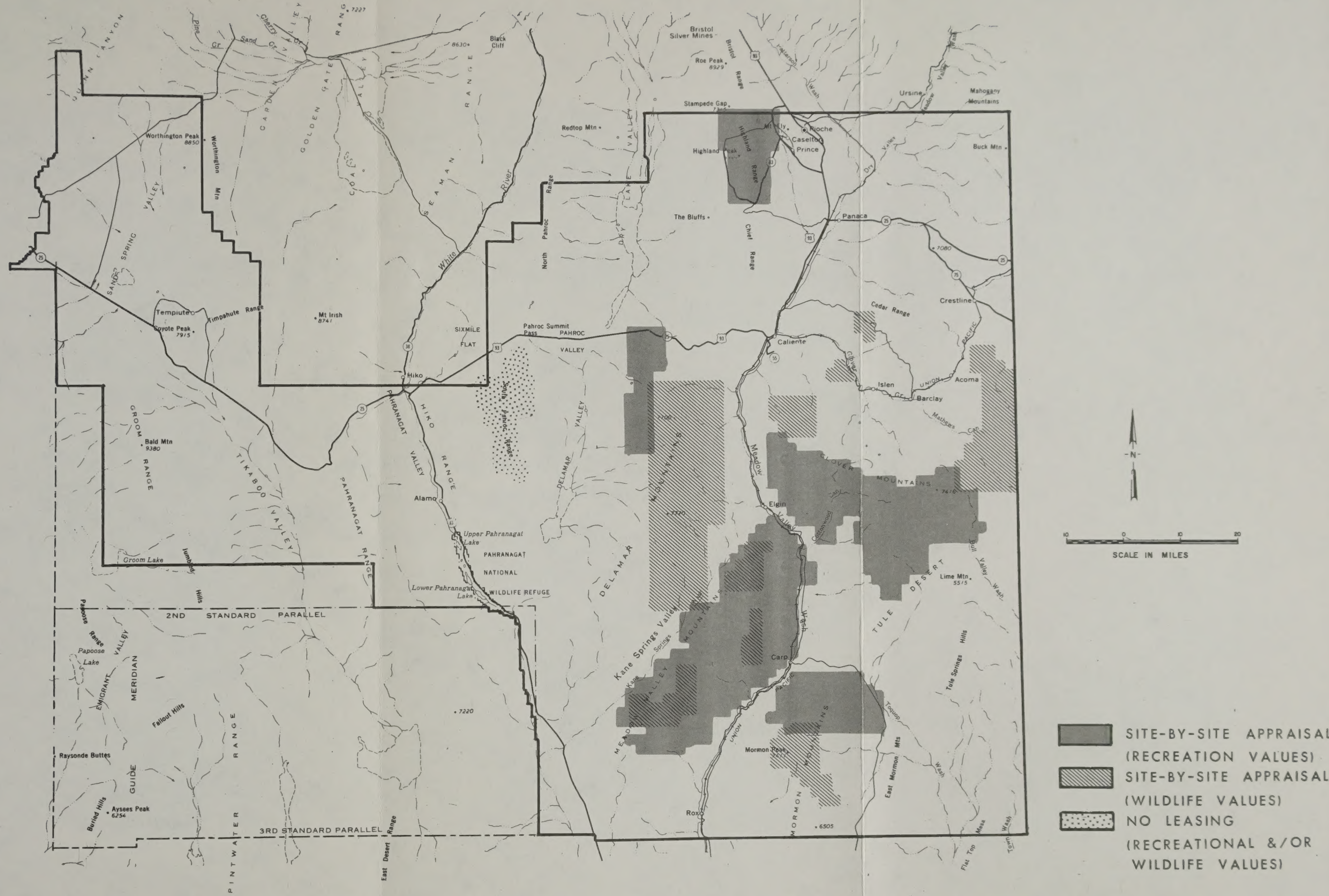
UNIQUE GEOLOGICAL AREAS

Virgin Valley Planning Unit

MAP #1D



UNIQUE GEOLOGICAL AREAS
Caliente Planning Unit
MAP #2



UNIQUE GEOLOGICAL AREAS

Caliente Planning Unit

MAP #2

Caliente MFP Step III Decisions

Recreation

1. Whenever possible, all improvements or development will be located outside the visual influence zone of roads. Necessary developments within visual influence zone will consider aesthetic values.

2. Where practical, no rights-of-way will be granted within visual influence zone of road segments RASG-4-23-28 (Nevada Highway 25 & U. S. 93 between Hiko and Caliente).

3. A systematic inventory will be conducted within the Caliente Resource Area by qualified archeologists to locate and identify all existing archeological sites.

4. Where possible and a need exists, archeological sites will be withdrawn from the general mining laws.

5. Botanical areas (Highland Range and Delamar Flat) will be protected for their aesthetic values. Where possible, resource development projects will not be allowed in areas shown on the MFP overlay.

6. Existing mining claims will be investigated within the Highland Peak Botanical area to determine their validity. If possible, the area will be withdrawn from general mining.

7. Recreation and mineral examinations should be made to determine if conflicts exist on the following areas: Beaver Dam Spires, Beaver Dam Wash, Bull Valley Wash, Rough Spires, Garden Spring Uplift, Manganese Ore Cliff, South Pahroc and Meadow Valley Wash. Where necessary and possible, areas will be protected from entry under general land and mining laws to protect their scenic values. Efforts will be made to protect these areas from other activities that might detract from their scenic value.

8. The South Pahroc will be designated as a primitive area. Other areas shown on the MFP III overlay will be studied to determine their primitive values and no further road construction will be allowed until completion of these studies.

9. Work will be done with mining companies to reduce impact of mining operations in Meadow Valley Wash, Clover Mts., Beaver Dam, N. and S. Pahroc Range, Pahranagat Range, N. Pintwater Range and East Panaca Plateau.

Wildlife

1. Minerals examinations will be made of crucial wildlife habitat to identify potential problems.

2. Vehicle travel in the Meadow Valley Range, Mormon Mountains, and any other crucial bighorn areas will be confined to designated roads and trails, except by permit.

3. Control burn sections of Mormon, Meadow Valley and Sawmill Ranges shown on wildlife MFP overlay.

Minerals

1. Conduct a detailed mineral investigation prior to any mineral or energy resource development.

2. Small areas around crucial wildlife habitat areas and water sources should be withdrawn from the general mining laws subject to valid and existing rights.

3. Mineral and energy resource leases will contain surface protection stipulations for the protection of other resources, especially fragile watersheds, wildlife and recreational values.

4. Exploration for geothermal energy will be encouraged.

Watershed

1. Maintain existing watershed cover conditions in areas which are relatively stable and improve watershed cover conditions in areas in which critical erosion condition by restricting uses which disturb the soil surface and vegetative cover (see MFP III overlay for location of restricted use areas).

Lands

1. Any improvements on rights-of-way granted adjacent to Highway 25 east of Panaca and along Highway 93 between Oak Springs Summit and Caliente must not be visible from these roads.

2. Place Ash Spring under a protective withdrawal.

Virgin Valley MFP Step III Decisions

Lands

1. Lands needed for the Valley of Fire State Park should be transferred to the State.

2. Range improvements and others of record will be protected from damage by right-of-way construction or will be repaired if damage occurs.

3. New major rights-of-way should generally be allowed only in existing corridors. No new corridors should be established unless that it would be in the public interest to do so.

4. The County and other agencies involved will be encouraged to maintain air pollution standards as established by EPA and to insure that these standards are complied with by private industry. Use of National Resource Lands by industries that could cause pollution should not be allowed until assurance is received that these standards will be met.

5. Areas having high environmental quality values will be protected so that these values are not destroyed.

6. a. The following areas will be designated as primitive areas:

    Arrow Canyon Range (RAPpr-012)
    Virgin Mountain (RAPpr-010)

   b. The following lands will be designated as scenic areas:

    Gold Butte (RASsc-027a)
    Mormon Mesa (RASgo-016)
    Flat Top Mesa (RASgo-015)
    Whitney Pockets (RASgo-017)
    Buffington Pockets (RASgo-023)

7. The follwoing sites will be designated as natural areas:

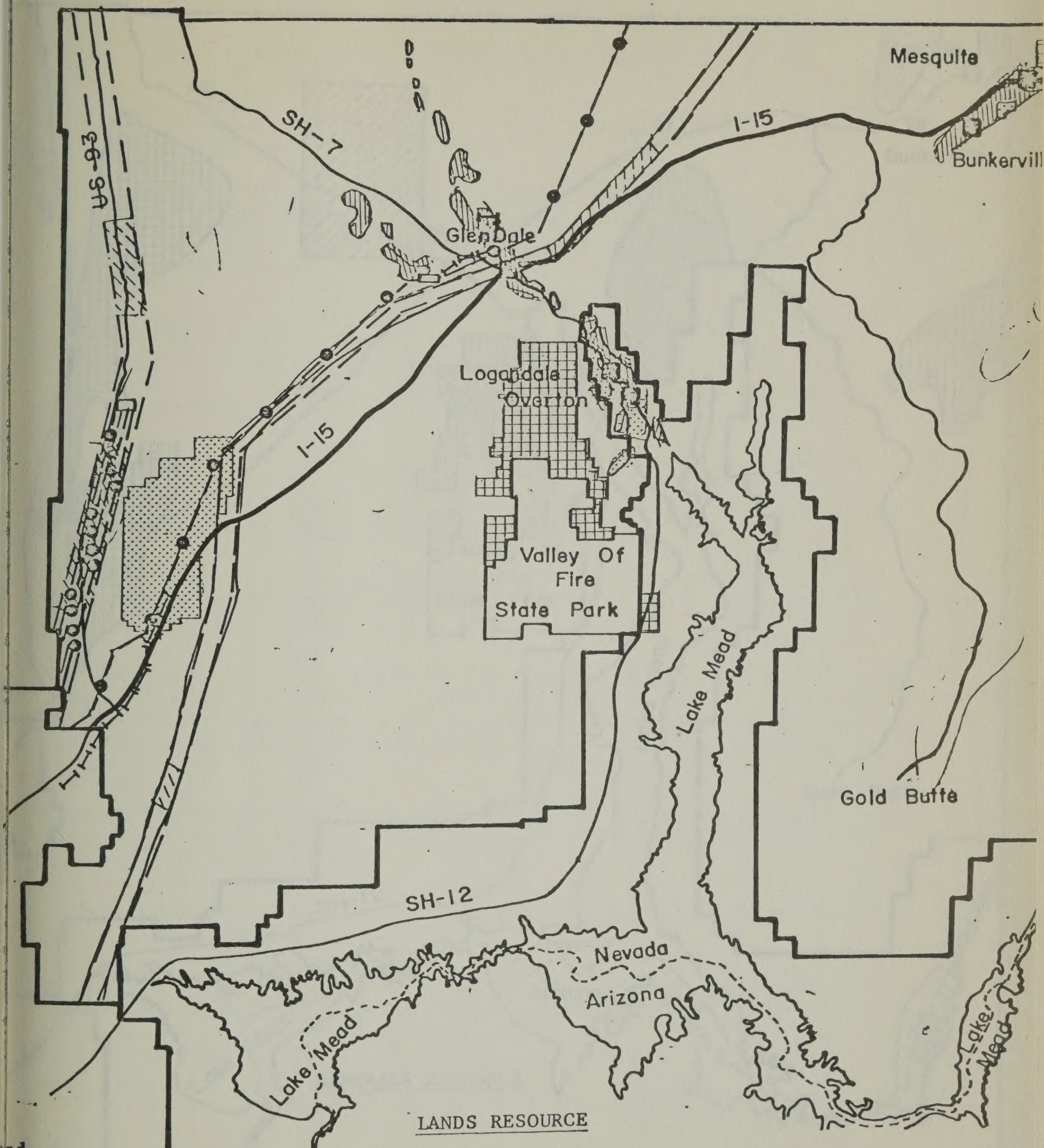
   a. Additional lands will be added to the Sunrise Mtn. Natural Area (RASgo-024).

   b. Paradise Valley Joshua Forest (RASbo-004).

Minerals

1. Areas proposed for withdrawal from general mining laws:

   a. Arrow Canyon Range (54,000 acres)



LANDS RESOURCE

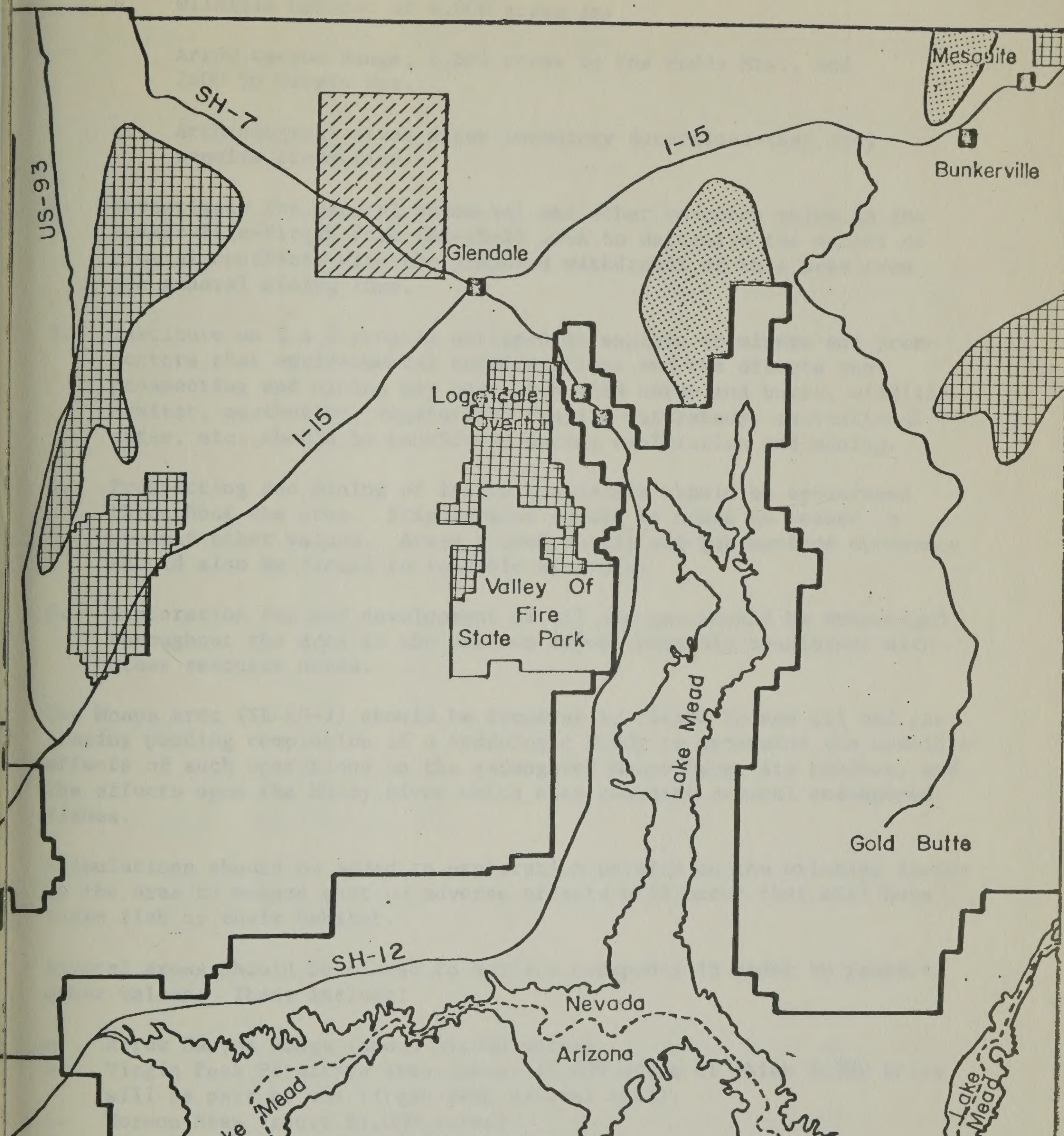
nd -

Powerlines Powerline Corridors Water Pipeline

Land disposal to local govt. under the Recreation & Public Purposes Act

Land disposal - urban, suburban, agricultural and industrial

... R/W ... lation area to protect recreation or watershed values



MINERALS RESOURCE

Legend

Potential Geothermal Area - Hydrologic study needed to assure protection of rare fish species

Proposed mineral withdrawal

Special lease stipulations required

b. Wildlife Habitat of 8,000 acres in:

Arrow Canyon Range, 8,000 acres in the Muddy Mts., and 2600 in Virgin Mts.

c. Archeological sites after inventory determines that they require protection.

2. Investigate the mineral potential and other resource value in the Bunkerville-Virgin Peak (SE-20-2) area to determine the extent of mineral conflicts with the proposed withdrawal of this area from the general mining laws.

3. Institute an I & E program designed to explain to miners and prospectors that environmental considerations and the effects that prospecting and mining may have upon wild horse and burro, wildlife habitat, aesthetics, vegetation, fragile watersheds, recreational sites, etc. should be considered during exploration and mining.

4. Prospecting and mining of leasable minerals should be encouraged throughout the area. Stipulations should be added as needed to protect other values. Areas closed to oil and gas surface occupancy should also be closed to leasable minerals.

5. Exploration for and development of oil and gas should be encouraged throughout the area to the maximum extent possible consistent with other resource needs.

The Moapa area (SE-20-7) should be temporarily closed to new oil and gas leasing pending completion of a hydrologic study to determine the possible effects of such operations on the endangered Moapa Dace, its habitat, and the effects upon the Muddy River which also contains several endangered fishes.

Stipulations should be added to exploration permits on the existing leases in the area to ensure that no adverse effects will occur that will harm these fish or their habitat.

Several areas should be closed to surface occupancy in order to protect other values. These include:

a. Arrow Canyon Range (about 54,000 acres)
b. Virgin Peak Primitive Area (about 27,000 acres of which 8,000 acres will be part of the Virgin Peak Natural Area).
c. Mormon Mesa (about 51,000 acres)
d. Flat Top Mesa (about 10,000 acres)
e. Paradise Valley Botanic Area at Gold Butte (about 11,000 acres)
f. Wildlife Habitat in the Muddy Mts. (about 8,000 acres) and the Arrow Canyon Range (about 8,000 acres)

Stipulations should be added to the lease as needed to protect other values throughout the planning unit.

6. The exploration for the development of geothermal resources should be encouraged throughout the area to the maximum extent possible consistent with other resource needs.

Each lease should be treated as though it would be fully developed.

The Moapa area (SE-20-7) should be temporarily closed to geothermal leasing and exploration pending completion of a hydrologic study to determine possible effects of such operations on the endangered Moapa Dace, its habitat, and the effects upon the Muddy River which also contains several endangered fishes.

Stipulations should be added to leases as needed to protect other resource values in the planning unit.

Watershed

1. Adequate measures to protect the fragile watershed areas from excessive soil disturbance will be used.

2. Issue no new rights-of-way which will encourage construction of additional access roads in crucial bighorn habitat. (See MFP Step III overlay for crucial areas).

Recreation

1. Permit no roads or rights-of-way in and remove litter and evidence of man's intrusions from Arrow Canyon (RASgo-020) and the Arrow Canyon Range (RASgo-022).

2. Steps should be taken to develop adequate protection and interpretation of archeological/paleontological sites found on National Resource Lands.

3. All sightseeing-scenery areas (RASsc) identified on MFP overlay should have:

   a. future construction of roads and rights-of-way designed to minimize visible scars on the landscape.

   b. development limited, insofar as technically and economically feasible, to existing sites and corridors.

   c. cooperation with miners, rights-of-way holders and range users to consider and insure the preservation or restoration of aesthetic values.

Forestry

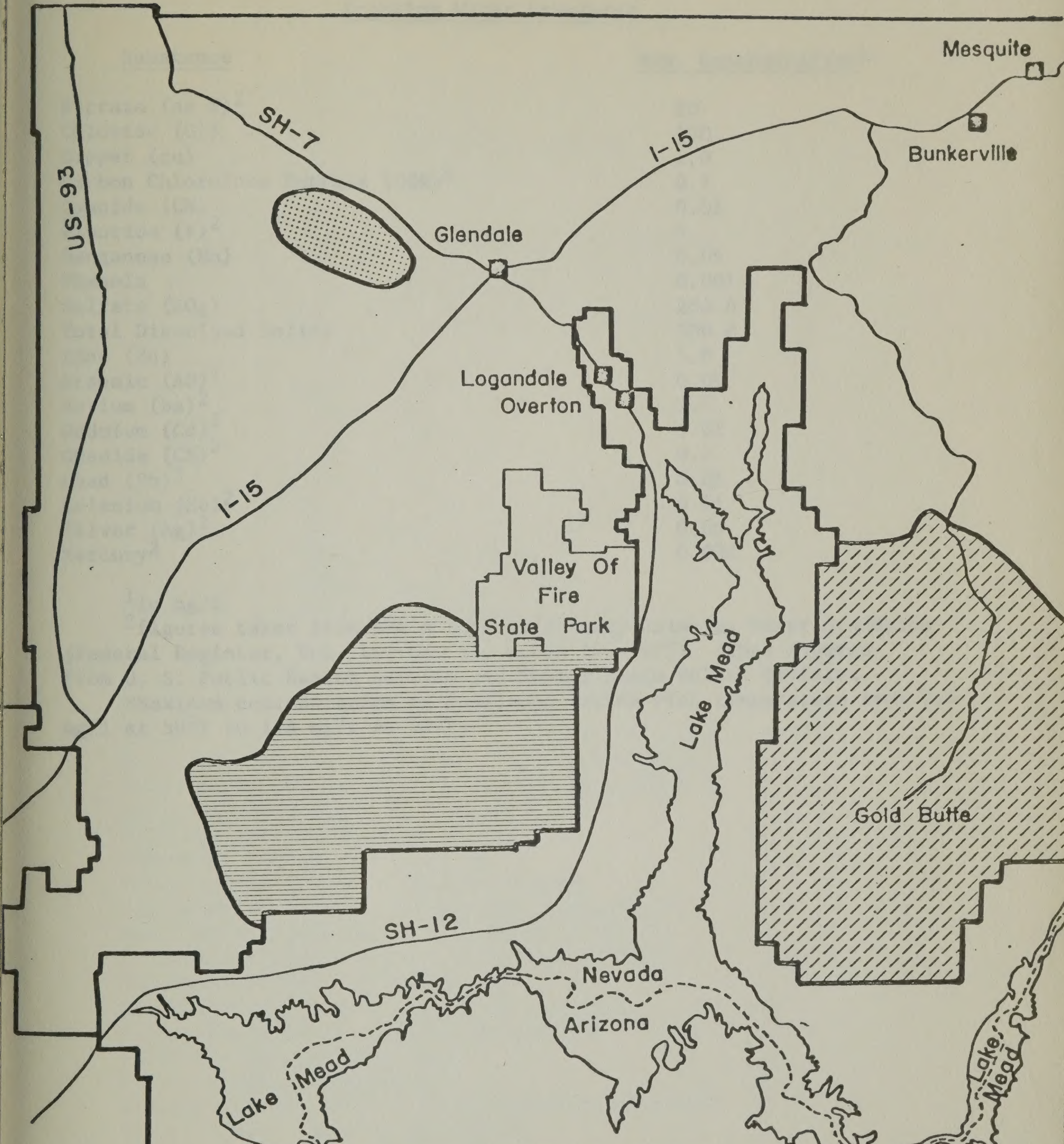
1. Place stipulations in minerals leasing and sale contracts to protect the wooded area.

2. Do not develop additional roads in the wooded areas.

3. Work with developers of locatable minerals to protect the Douglas fir, white fir, pinyon-juniper and Joshua trees.

Wild Horses and Burros

1. The area manager will place proper stipulations in leasable mineral contracts to protect burro habitat and burros.



WILDHORSES AND BURROS RESOURCE

Legend

Burro Removal Area

Horse Removal Area

Established Burro Area

Drinking Water Standards

Substance	Max. Concentration[1]
Nitrate (as N)[2]	10
Chloride (Cl)	250
Copper (cu)	1.0
Carbon Chloroform Extract (CCE)[2]	0.7
Cyanide (CN)	0.01
Fluoride (F)[2]	*
Manganese (Mn)	0.05
Phenols	0.001
Sulfate (SO_4)	250.0
Total Dissolved Solids	500.0
Zinc (Zn)	5.0
Arsenic (AS)[2]	0.05
Barium (Ba)[2]	1.0
Cadmium (Cd)[2]	0.01
Cyanide (CN)[2]	0.2
Lead (Pb)[2]	0.05
Selenium (Se)[2]	0.01
Silver (Ag)[2]	0.05
Mercury[2]	0.002

[1]in mg/l

[2]figures taken from EPA's Interim Primary Drinking Water Standards (Federal Register, Vol. 40, No. 51, March 14, 1975); other figures from U. S. Public Health Service and Nevada State Helath Division.

*Maximum concentration of F allowed varies with temperature from 2.4 mg/l at 50°F to 1.4 mg/l at 90°F.

Mammals - Caliente and Virgin Valley Planning Unit

Insect-Eaters - Order Insectivora
- Merriam Shrew - Sorex merriami
- Gray (Desert) Shrew - Notiosorex crawfordi
- Inyo shrew - Sorex tenellus

Bats - Order Chiroptera
- California leaf-nosed bat - Macrotis californicus
- California myotis bat - Myotis californicus
- Big free-tailed bat - Tadarida molossa
- Mexican free-tailed bat - Tadarida brasiliensis
- Pallid bat - Antruzous pallidus
- Long-eared bat - Myotis evotis
- Spotted bat - Euderma maculata
- Hoary bat - Lasiurus cinereus
- Big brown bat - Eptesicus fuscus
- Red bat - Lasiurus borealis
- Western pipistrelle - Pipistrellus hesperus
- Silvery-haired bat - Lasionycteris noctivagans
- Small-footed myotis - Myotis subulatus
- Fringed myotis - Myotis thysanodes
- Little brown myotis - Myotis lucifugus
- Townsend's big-eared bat - Plecotus townsendi

Rodents - Order Rodentia
- Townsend ground squirrel - Citellus townsendi
- Rock squirrel - Citellus variegatus
- White-tailed antelope squirrel - Ammospermophilus leucurus
- Round-tailed ground squirrel - Citellus tereticaudus
- Gold-mantled ground squirrel - Citellus lateralis
- Least chipmunk - Eutamias minimus
- Cliff chipmunk - Eutamias dorsalis
- Porcupine - Erethizon dorsatum
- Valley pocket gopher - Thomomys bottae
- Little pocket mouse - Perognathus longimembris
- Great Basin pocket mouse - Perognathus parvus
- Long-tailed pocket mouse - Perognathus formosus
- Ord Kangaroo Rat - Dipodomys ordi
- Merriam kangaroo rat - Dipodomys merriami
- Desert kangaroo rat - Dipodomys deserti
- Muskrat - Ondatra zibethica
- Beaver - Castor canadensis
- Western harvest mouse - Reithrodontomys megalotis
- Canyon mouse - Peromyscus crinitus
- Cactus mouse - Peromyscus eremicus
- Brush mouse - Peromyscus boylei
- Deer mouse - Peromyscus maniculatus
- Pinyon mouse - Peromyscus truei
- Meadow mouse - Microtus montanus
- House mouse - Mus musculus

Southern grasshopper mouse - Onychomys torridus
Desert woodrat - Neotoma lepida
Bushy-tailed woodrat - Neotoma cinerea
Sagebrush vole - Lagurus curtatus
Mountain vole - Microtus montanus
Dark kangaroo mouse - Microdipodops megacephalus
Pale kangaroo mouse - Microdipodops

Horses and Rabbits - Order Lagomorpha
Blacktail jackrabbit - Lepus californicus
Desert cottontail - Sylvilagus auduboni
Mountain cottontail - Sylvilagus nuttali

Carnivores - Order Carnivora
Cougar - Felis concolor
Coyote - Canis latrans
Bobcat - Lynx rufus
Kit fox - Vulpes macrotis
Gray fox - Urocyon cinereoargenteus
Badger - Taxidae taxus
Spotted skunk - Spilogate putorius
Striped skunk - Mehpitis mephitis
Long-tailed weasel - Mustela frenata
Ring-tailed cat - Bassariscus astutus
Raccoon - Procyon lotus

Even-toed Herbivores - Order Antiodactyla
Bighorn sheep - Ovis canadensis
Mule deer - Odocoileus hemionus
Antelope - Antilocapra americana

Odd-toed Herbivores - Order Perissodactyla
Burro - Equus assinus
Horse - Equus caballus

Reptiles & Amphibians
Caliente & Virgin Valley Planning Units

AMPHIBIANS

Frogs:

Bullfrog - Rana catesbeiana. Large, olive or brown above, whitish-grey below. Conspicuous eardrums. Very aquatic.

Pacific Treefrog - Hyla regilla. Small frog with toe pads. Green, tan, gray or black. Low plant growth near streams.

Toads:

Great Basin spadefoot toad - Scaphiopus intermontanus. Small ash grey. Sagebrush flats, pinyon-juniper woods.

Southwestern toad - Bufo micreoscaphus. Greenish or brown above, buff below. Nocturnal. Brooks or streams.

Red-spotted toad - Bufo punctatus. Light grey-reddish brown with red or orange warts. Nocturnal. Grassland, rocky canyons near springs.

REPTILES

Lizards:

Banded gecko - Coleonyx variegatus. Pink or yellow with brown bands. Rocky areas, creosote, pinyon-juniper.

Gilbert's skink - Eumeces gilberti. Olive or brown above with dark spotting. Rocky areas near streams.

Western skink - Eumeces skiltonianus. Brown, black, and white dorsal strips. Rocky areas, woodland.

Desert lguana - Dipsosaurus dorsalis. Gray with blotches on sides and tail. One row of enlarged scales down the back. Creosote bush, sandy habitat.

Zebra-tailed lizard - Callisaurus draconoides. Slim lizard with long tail and legs, black bars on under surface of tail. Open areas, firm soil.

Collared lizard - Crotaphytus collaris. Stocky lizard with black and white collar. Rocky gullies, canyons.

Chuckwalla - Sauromalus obesus. Large, dark with folds of skin on necks and sides. Rocky area.

Gila monster - Heloderma suspectum. Large, bright black, pink and orange. Poisonous. Deserts, near washes and intermittent streams.

Leopard lizard - Crotaphytus wislizenii. Large lizard with leopard like spots; can change color. Arid plains with Bunch-grass, sagebrush, creosote.

Desert spiny lizard - Sceloporus magister. Yellowish-brown with black wedge - shaped mark on neck. Low slopes, Joshua tree, creosote bush, juniper.

Western fence - Sceloporus occidentalis. Very common. Black, gray or brown with dark blotches, blue belly. Rocks, logs, buildings.

Sagebrush lizard - Sceloporus graciosus. Grey or brown with blue belly patches, black bar across shoulder. Open area, sagebrush, low shrubs.

Side-blotched lizard - Uta stansburiana. Very common. Brown with black blotch on side of the chest. Sand, rock, loam, grass, bushes, sparse trees.

Desert horned lizard - Phrynosoma platyrhinos. Beige, reddish, or gray with rows of fringed scales along each side of the body. Creosote bush, cactus, sagebrush.

Desert night lizard - Xantusia vigilis. Small, olive, grey or brown with tiny black spots. Lives under fallen branches of yucca and in rock crevices.

Western whiptail - Cnemidophorus tigris. Grey, yellowish, or tan with black spots or bars. Open area, sand or rocky soil.

Snakes:

Ringneck - Diadophis punctatus. Olive or black with orange neck ring. Mts., elevations over 2400 feet.

Striped whipsnake - Masticophis taeniatus. Black, brown or gray with white stripe on each side. Rock outcrops.

Coachwhip (Red racer) - Masticophis flagellum. Reddish or pinkish with black crossbands. Open desert, sand or rock.

Western patch-nosed - Salvadora hexalepis. Thin with yellow stripe down the back and large patch like rostral. Sandy and rocky soils.

Spotted leaf-nosed - Phyllorhynchus decurtatus. Small, pale pink or tan with brown blotches. Sandy or gravelly desert. Uncommon.

Western Shovel-nosed - Chionactis occipitalis. Uncommon. Whitish with brown or black crossbands, shovel-like snout. Sandy gullies, dunes, washes.

Racer - Coluber constrictor. Brown or olive above, yellow below. Semi-arid, open habitat.

Glossy snake - Arizona elegans. "Faded" brown, pink or yellow color with tan or gray blotches. Sagebrush flats.

Gopher snake - Pituophis melanoleucus. Large yellow or beige with black or brown blotches. Hisses loudly like rattlesnake when alarmed, but is not poisonous. Sand, loam or rock.

Common (California) kingsnake - Lampropeltis zonata. Shiny rings of black or brown and white or yellow. Rock outcrops, old lumber piles.

Long-nosed - Rhinocheilus lecontei. Pinkish or reddish with black saddles, white belly. Deserts, brushland.

Wester garter - Thamnophis elegans. Uncommon. Stripe down the center of the back. Brushland, sometimes aquatic.

Sonora Lyre - Trimorphodon lambda. Uncommon. Light brown-gray with brown blotches. Lyre-shaped mark on top of broad head. Rocky areas.

Western ground snake - Sonora semiannulata. Small, glossy snake. Large variety of colors and patterns. Sagebrush, creosote, willows, loose soil.

Night snake - Hypsiglena torquata. Small, gray or beige with large brown neck blotches. Rocky and sandy areas.

Western blind snake - Leptotyphlops humilis. Small with blunt head and tail, vestigial eyes. Rocky hillsides with loose soil, near streams.

Speckled Rattlesnake - Crotalus mitchelli. Cream, gray, brown to match habitat, speckled with black and white. Poisonous. Rocky areas, open brushland, pinyon-juniper.

Mohave Rattlesnake - Crotalus scutulatus. Greenish-gray with diamond like pattern down the back. Poisonous. Desert, brushland.

Spotted leaf-nosed - Phyllorhynchus decurtatus. Small, pale pink or tan with brown blotches. Sandy or gravelly desert. Uncommon.

Western Shovel-nosed - Chionactis occipitalis. Uncommon. Whitish with brown or black crossbands, shovel-like snout. Sandy gullies, dunes, washes.

Racer - Coluber constrictor. Brown or olive above, yellow below. Semi-arid, open desert.

Glossy snake - Arizona elegans. Faded brown, pink or cream color with tan or gray blotches. Sagebrush areas.

Gopher snake - Pituophis catenifer deserticola. Large yellow or cream with black or brown blotches. Hisses loudly like rattlesnake when alarmed, but is not poisonous. Sand, loam or rock.

Common (California) Kingsnake - Lampropeltis getulus. Shiny rings of black or brown and white or yellow. Rock outcrops, old lumber piles..

Long-nosed - Rhinocheilus lecontei. Yellowish or reddish with black saddles. White belly. Deserts, farmlands.

Western garter - Thamnophis elegans. Uncommon. Stripe down the center of the back. Sprinklers, meadows, marsh.

Sonora lyre - Trimorphodon lambda. Uncommon. Light brown-gray with brown blotches. Lyre-shaped mark on top of broad head. Rocky areas.

Western ground snake - Sonora semiannulata. Small, glossy snake. Large variety of colors and patterns. Washes, creosote, willows, loose soil.

Night snake - Hypsiglena torquata. Small, gray or beige with large brown neck blotches. Rocky and sandy areas.

Western blind snake - Leptotyphlops humilis. Small with blunt head and tail, vestigial eyes. Dark, brownish in loose soil, near streams.

Speckled Rattlesnake - Crotalus mitchelli. Cream, gray, brown to match habitat, speckled with black and white. Poisonous. Rocky areas, open brushland, pinyon-juniper.

Mohave Rattlesnake - Crotalus scutulatus. Greenish-gray with diamond like pattern down the back. Poisonous. Deserts, brushland.

Sidewinder - Crotalus cerastes. Pale tan, pink or gray. Moves in S-shaped curve. Fine sand, near rodent burrows.

Turtles, Tortoises;

Desert tortoise - Gopherus agassizi. Brown, high-domed shell, stocky scaly limbs. Desert oases, washes, dunes.

Fishes
Virgin Valley & Caliente Planning Units

Herring and Shad - Family Clupeidae

Threadfin Shad - Dorosoma petenense atchafalayae
Introduced into Lake Mead

Salmon and Trout - Family Salmonidae

Rainbow Trout - Salmo gairdneri
Introduced into Lake Mead

Lahotan Cutthroat Trout - Salmo clarki henshawi
Introduced into Lake Mead, Clover & Beaver Dam Creeks

Brook trout - Salvelinus fontinalis
Meadow Valley Wash

Silver Salmon - Oncorhynchus kisutch
Introduced into Lake Mead

Suckers - Family Catostomidae

Mountain sucker - Pantosteus clarki
Virgin River, Meadow Valley Wash, Clover & Beaver Dam Creeks

Razorback (or Humpback) Sucker - Xyrauchen texanus
Status in Lake Mead uncertain

Catfishes - Family Ictaluridae

Channel Catfish - Ictalurus punctatus
Muddy and Virgin Rivers, Lake Mead

Black Bullhead Catfish - Ictalurus melas
Muddy River, Lake Mead

Killifishes - Family Cyprinodontidae

White River Springfish - Crenichthys baileyi
Muddy River, Ash, Crystal and Warm Springs

Topminnows - Family Poecilidae

Mosquitofish - Gambusia affinis
Muddy and Virgin Rivers and Warm Springs

Shortfin Molly - Poecilia mexicana
Introduced into Muddy River

Black Mollies - Mallienesia latipinna
Guppies - Lebistes reticulatus
Swordtails - Xiphophorus helleri
and Platys - Xiphophorus maculatus
Introduced into Rogers Spring, Ash Spring

Carps and Minnows - Family Cyprinidae

Colorado Gila - Gila robusta
Muddy and Virgin Rivers

Swiftwater Colorado Gila - Gila elegans
Lake Mead

Pahranagat Bonytail Chub - Gila robusta jordani
Crystal Spring

Colorado River Bonytail - Gila robusta elegans

Redshiner - Notropis lutrensis
Muddy and Virgin Rivers

Golden Shiner - Notemigonus crysoleucas
Introduced into Muddy and Virgin Rivers

White River Speckled Dace - Rhinichythys osculus velifer
Muddy River, Pahranagat Valley, Meadow Valley Wash

Moapa Dace - Moapa coriacea
Upper Muddy River, private springs

Asiatic Carp - Cyprinus carpio
Muddy and Virgin Rivers, Lake Mead, Pahranagat Valley

Goldfish - Carassius auratus
Introduced into Warm Springs

Fathead Minnow - Pimephales promelas
Introduced into Muddy and Virgin Rivers, Lake Mead

Virgin River Spinedace - Lepidomeda mollispinis mollispinis
Virgin River

Woundfin - Plagopterus argentissimus
Virgin River only

Sunfish, Basses and Crappies - Family Centratchidae

Largemouth Bass - Micropterus salmoides
Lake Mead, Muddy River, Pahranagat Valley

Striped Bass - Roccus saxatilis

Bluegill sunfish - Lepomis macrochirus
Lake Mead

Green Sunfish - Lepomis cyanellus
Lake Mead

Black Crappie - Pomoxis nigromaculatus
Lake Mead

/ / - Classified "endangered" by Federal government and/or "rare or endangered" by the State of Nevada

Birds - Caliente and Virgin Valley Planning Unit

See pamphlet "Birds - Las Vegas BLM District"

LIVESTOCK OPERATORS

Caliente Resource Area

John Ballow
Rachel Ballow
Paul & Myrtle Bliss
Fenton & Margie Bowler
Guy Bowler
Richard & Helen Bowler
Mrs. Lewis Bowler
Bradshaw, Inc.
Charles & Helen Brundy
Buckhorn Land & Cattle Co.
Dennis Iverson
Erwin Burns
Ronald & Delores Cannon
Clark Livestock Corp.
Lom Thompson
Urban & Esther Cole
Rose Marie Condie
Bar I Bar Cattle Co.
Charles Culverwell Estate
D/4 Enterprises, Inc.
Albert Delmue
Albert & Frank Delmue
Delmue Brothers
Frank and Rose Delmue
Foremaster Brothers
Albert Ferhner
Al Martin & John Crockett
Hafen Brothers
James S. & Jerry L. Haworth
Mrs. Otelia Henrie
Ernest Higbee
Joe V. & Edwin Higbee
David Jensen
Lehi Jones
H. Wendell Hones
William L. Jones
Jamie Keyes
Lambeth Brothers
Donald Lamoreaux
Edwin Larson
Edwin Larson & Arnold Anderson
Kenneth & Gordon Lytle
Norman Gubler
Andrew Lytle
Ezra Lytle
Rodney Burgres
Talmage Lytle
McCrosky Brothers
Mathews Brothers Ranch
Clyde Mathews Estate
Richard Palombi
Chester Oxborrow
Bertrand Paris & Sons
Harry Randall
Henry & Virginia Rice
Henry Rice & Sam Johnson
Jimmie Rosa
Rachel Schlarman Estate
Ray S. Schmutz
G M & N Sharp
A. J. Sharp
Lawrence Sharp Estate
Snow's Lazy S-I Ranch Inc.
Heber Staheli
Rodney Staheli
Leo A. Stevens
Messrs. Alden L., Neil, G.L., and Harold Stewart
Leo K. Stewart
Stratton Brothers
Summa Corporation
Leon Bowler
James B. Tennille, Jr.
Evan G. Tobler
F. Don Wadsworth
James A. Wadsworth & Sons
John & Margaret Wadsworth
Leonard & Earl Wadsworth
William Casey
Kent Whipple
Alex B. Williams
Earl C. Williams
William Jay & Marjorie Wright
Rulon Cox
Roy Lundgren
C. Kenneth Lee Estate

Virgin Valley Resource Area

Irvin Adams
David Bundy
William Clough
Roland Esplin
Phillip Foremaster
Larry & Grayce Hardy
Leo & Camelia Hardy
John & Helen Hendricks
Charles L. Hester
Melburn Jensen
Clayton Jones
Aaron Leavitt
Emerson Leavitt
Lowell Leavitt
C. A. Lewis
Paul C. Lewis
Keith Nay
G. M. Perkins
Robert Perkins, Jr.
William Pulsipher
Kenneth Searles
Dale Hunt
Harold Whittwer

ANALYSIS OF

COMMENTS ON THE DRAFT

ENVIRONMENTAL ANALYSIS RECORD

UNITED STATES GOVERNMENT

Memorandum

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Nevada State Office
Room 3008 Federal Building
300 Booth Street
Reno, Nevada 89509

IN REPLY REFER TO:
N-12574
3100/3200
(N-930.7)

TO : Chief, Planning Coordination Staff (N-911) Date: February 24, 1976

FROM : Chief, Division of Resources

SUBJECT : Caliente-Virgin Valley Draft ~~Oil~~ and Gas/Geothermal EAR

The subject EAR has been reviewed by the Wildlife and Geothermal Specialists and they offer the following comments:

1. General Comments

   Report should be reviewed for coherence by NSO Planning Coordination Staff. The "mitigating measures" listed are acceptable, but should not be put forth as special stipulations because they are simply duplication of what appears in GRO orders. Areas which are "sensitive" such as natural or roadless areas, critical habitat, etc., should be listed as "no leasing pending further environmental study".

2. Specific Comments

   Page 26 - Fugitive dust - Although the Clark County standards say it must not cross property lines, there should be a comment on natural dust here.

   Page 29 - Soil nutrient properties - Soils may have low natural nutrient properties but the reason for sparse vegetal cover is more likely to be low rainfall rather than a nutrient limitation.

   Page 30 - Should make a comment here that most of the lands in this EAR are NRL; therefore, any erosion at all would be from such lands.

   Page 35, first line - Revise to read: Large amounts of water are available from sub-surface reservoirs. Approximately 120,000 acre-feet are available in the Virgin Valley Planning Unit alone. (Should state whether the 120,000 acre-feet is yearly sustained yield or actual storage volume.)

   Page 35, Recommendation F-- Concentration varies with average annual daily maximum air temperature (1.4 ppm @ 80-91°F to 2.4 ppm @ 50-54°F - p. 66 <u>in</u> Water Quality Criteria EPA - 1972).

   Page 43, 3rd paragraph - Should read "A permanent population of mountain lions is scattered...." Last line should read "Little information is available on numbers, density, habits, etc. of these animals."

Page 44 - Recommend that the Fish and Wildlife Service be asked to find out if there are any spotted bats in the area.

Page 45, first paragraph - Recommend Fish and Wildlife Service "do their thing" regarding delineation of nesting areas for "Falconiformes".

Page 47 - State that the photo is "high stage".

Page 55, second paragraph - Define allelopathic.

Page 63 - Asbestos requires long term exposure to asbestos fabrication environments--probably not the case around cooling towers.

Page 64 - Delete reference to ammonia. This is not significant even on a small scale where rain is less than 5" per year.

Page 65, third paragraph - Qualify the paragraph with the statement that the fish will be affected <u>if</u> groundwater is withdrawn or accidental spills occur. If closed loop (binary) systems are employed, then there will be no fluid withdrawal.

Page 67, second paragraph - Change to read "...are torn down, evidence of the site will...."

Page 80 - Please make a decision--either allow leasing with special stipulations or say no leasing pending further environmental study.

Page 89 - Minerals #4 Exploration for geothermal energy is encouraged but the tone of the EAR is "no lease"--does not square; these opposite viewpoints.

Page 94, item #6, fourth line - One can't predict where or how geothermal energy will develop. In this EAR there appears little likelihood of any development for electrical power generation.

Page 97 - Reference where these criteria came from--latest EPA data are somewhat different.

Page 110 - Delete paragraph on coal--not relevant to discussion, but include a couple of sentences on presence or absence of oil shale.

Page 44 - Recommend that the Fish and Wildlife Service be asked to find out if there are any spotted bats in the area.

Page 45, first paragraph - Recommend Fish and Wildlife Service "do their thing" regarding delineation of nesting areas for "Falconiformes".

Page 47 - State that the photo is "high stage".

Page 53, second paragraph - Define elasmobranchs.

Page 63 - Asbestos requires long term exposure to asbestos fabrication environments--probably not the case around cooling towers.

Page 64 - Delete reference to cements. This is not significant even on a small scale where rate is less than 1" per year.

Page 65, third paragraph - Qualify the paragraph with the statement that the fish will be affected if groundwater is withdrawn or accidental spills occur. If closed loop (binary) systems are employed, then there will be no fluid withdrawal.

Page 67, second paragraph - Change to read "...site were torn down, evidence of the site will...."

Page 80 - Please make a decision--either allow leasing with special stipulations or say no leasing, pending further environmental study.

Page 89 - Minerals #6 Exploration for geothermal energy is encouraged but the tone of the EAR is "no lease"--does not square these opposite viewpoints.

Page 90, item #6, bottom line - One can't predict where or how geothermal energy will develop. In this EAR there appears little likelihood of any development for electrical power generation.

Page 92 - Reference where these criteria came from--latest EPA data are somewhat different.

Page 110 - Delete paragraph on coal--not relevant to site area, but include a couple of sentences on presence or absence of oil shale.

NEVADA STATE OFFICE

Comment: III.A.1.b. Air Quality

Fugitive dust - Although the Clark County standards say it must not cross property lines, there should be a comment on natural dust here.

Response:

Natural dust is mentioned later in the Chapter - "The air quality throughout most of the study area is good except during high winds when dust is a problem."

Comment: III.A.2.B. Soils

Soil nutrient properties - Soils may have low natural nutrient properties but the reason for sparse vegetal cover is more likely to be low rainfall rather than a nutrient limitation.

Response:

The scarcity and limited variety of vegetation is caused by both low rainfall _and_ poor soils. _One_ indicator of low nutrient properties in soils is sparse vegetation.

Comment: III.A.2.b. Soils

Should make a comment here that most of the lands in this EAR are NRL; therefore, any erosion at all would be from such lands.

Response:

Though most of the lands are NRL, it doesn't necessarily follow that any and all erosion occurs on NRL. In fact, erosion is also occurring on private lands like those along Clover Creek.

Comment: Caliente MFP Decisions (Appendix)

Minerals #4 Exploration for geothermal energy is encouraged but the tone of the EAR is "no lease"--does not square; these opposite viewpoints.

Response:

The goal of BLM is to encourage multiple use of the land. Geothermal energy is encouraged where and in such a way that it doesn't eliminate other uses like wildlife, vegetation, recreation,

etc. The Management Framework Plan identifies certain resource values that need protection and the EAR analyzes the effect of geothermal exploration and development on these vaues. If one looks at the maps which outline areas closed to geothermal activity, one can see that they comprise a minority of the NRL in the two planning units.

Comment: III.B.2. Wildlife

Recommend that the Fish and Wildlife Service be asked to find out if there are any spotted bats in the area.

Recommend Fish and Wildlife Service "do their thing" regarding delineation of nesting areas for "Falconiformes".

Response:

These suggestions are now included as possible and suggested mitigating measures for wildlife.

Comment: iv. A.1.a. Hazards

Asbestos requires long term exposure to asbestos fabrication environments--probably not the case around cooling towers.

Response:

The asbestos hazard was identified in the final environmental statement for the geothermal leasing program (see Vol. 1, III-27).

Comments:

III.A.3.a. Surface & Ground Water
Revise to read: Large amounts of water are available from sub-surface reservoirs. Approximately 120,000 acre-feet are available in the Virgin Valley Planning Unit alone. (Should state whether the 120,000 acre-feet is yearly sustained yield or actual storage volume.)

III.A.3.b. Water Quality
Recommendation F--Concentration varies with average annual daily maximum air temperature (1.4 ppm @ 80-91^{o}F to 2.4 ppm @ 50-54^{o}F - p. 66 in Water Quality Criteria EPA - 1972).

III.B.2. Wildlife
Should read "A permanent population of mountain lions is scattered..." Last line should read "Little information is available on numbers, density, habits, etc. of these animals."

III.B.2. Wildlife
State that the photo is "high stage".

III.C. Ecological Interrelationship
Define allelopathic.

IV.A.1.a. Vegetation
Delete reference to ammonia. This is not significant even on a small scale where rain is less than 5" per year.

IV.A.1.b. Wildlife
Quality the paragraph with the statement that the fish will be affected _if_ groundwater is withdrawn or accidental spills occur. If closed loop (binary) systems are employed, then there will be no fluid withdrawal.

IV.A.1.d. Landscape Character
Change to read "...are torn down, evidence of the site will..."

Drinking Water Standards (Appendix).
Reference where these criteria came from--latest EPA data are somewhat different.

Response:

Text amended as suggested.

Comment: Technical Report

Delete paragraph on coal--not relevant to discussion, but include a couple of sentences on present or absence of oil shale.

Response:

We find the mention of coal relevant in the context of this technical report. Some changes have been made in the technical report, however.

Comment: Unique Geographical Areas (Appendix)

Please make a decision--either allow leasing with special stipulations or say no leasing pending further environmental study.

Response:

This section identified areas with special values in which leasing may be allowed with special stipulations. But to establish these stipulations site-by-site appraisals will be necessary.

Comment: Virgin Valley MFP Decisions (Appendix)

Item #6, fourth line - One can't predict where or how geothermal energy will develop. In this EAR there appears little likelihood of any development for electrical power generation.

Response:

Since once a geothermal, oil or gas permit is issued, the permittee has prior rights to development if a find is made, we thought it best to consider the consequences of full development even though in most cases in this District full development may never occur.

N-12574
(3100)

STATE OF NEVADA
GOVERNOR'S OFFICE OF PLANNING COORDINATION
CAPITOL BUILDING, ROOM 45
CAPITOL COMPLEX
CARSON CITY, NEVADA 89710
(702) 885-4865

March 24, 1976

Mr. E.I. Rowland
Nevada State Director
U.S. Department of the Interior
Bureau of Land Management
300 Booth Street
Rm. 3008 Federal Building
Reno, Nevada 89509

Re: Oil, Gas & Geothermal E.A.R. for Caliente-Virgin Valley Resource Area
SAI NV #76800044

Dear Mr. Rowland:

Attached are comments from the following affected State agencies; Nevada State Park System; Nevada Department of Fish & Game; Nevada Department of Highways; Division of Colorado River Resources; Advisory Mining Board; and Environmental Protection Services, concerning the above referenced E.A.R..

These comments constitute the State Clearinghouse review of this proposal, and we would appreciate it if you would incorporate these comments in your final E.A.R..

Sincerely,

Bruce D. Arkell
State Planning Coordinator

BDA/dm
attachment
cc: Nevada State Park System
Nevada Dept. of Fish & Game
Nevada Dept. of Highways
Nevada Dept. of Conservation & Natural Resources, Div. of Colorado River Resources
Nevada Dept. of Human Resources, Environmental Protection Services
Advisory Mining Board

State of Nevada
Department of Fish and Game

GLEN K. GRIFFITH
DIRECTOR

MIKE O'CALLAGHAN
GOVERNOR

VALLEY ROAD P.O. BOX 10678 RENO, NEVADA 89510 TELEPHONE (702) 784-6219

March 11, 1976

Mr. Bruce D. Arkell
Planning Coordinator
Governor's Office
Capitol Building, Rm. 45
Carson City, Nev. 89701

Dear Mr. Arkell:

Reference is made to SAI NV #76800044 Oil, Gas & Geothermal E.A.R. for Caliente-Virgin Valley Resources Area.

The following are comments of the Department of Fish and Game concerning this E.A.R.

1. Major direct and secondary impacts on State.

   Loss of fish and wildlife populations and habitat can and probably will occur in proportion to amount of land area devoted to geothermal and oil and gas exploitation.

2. Major indirect impacts on state.

   Hunting and fishing and other recreational opportunities can be decreased commensurate with the magnitude of development.

Attached are additional comments from this Department.

Sincerely,

Glen K. Griffith
Director

Additional comments concerning SAI NV #76800044

Page 9 - Land Uses

This section does not put wildlife usage of forage and recreational use (in form of consumptive and non-consumptive) into proper perspective. Mention is made of hunting recreation on the Overton WMA, yet in Paragraph 2, it states that recreation, agriculture and mining seem to be the major land uses. The wildlife resource value should be shown in terms of hunter use days by species, by county and at least assign the average dollar value of a hunter use day and wildlife observation day. Wildlife resources are in fact a multi-million dollar resource when you consider populations needed to sustain a given harvest level, forage requirement value and monies expended by recreationists.

Page 10 - 5th paragraph - Ponds

Wilson, Feour, Nesbitt Reservoir (lake), Schroeder Reservoir and Echo Canyon Reservoir.

Page 14

Under this wildlife section and the appendix for wildlife species, they fail to list antelope. Antelope occur in lower Lake Valley near Pioche seasonally on occasion and also are frequently observed in Sand Spring Valley and to a lesser extent in Tikaboo Valley. The latter two valleys are not now herd units that are hunted, but future inventories will likely portray increased populations and possibly limited hunting will be allowed.

Page 15 - 6th paragraph

"Furbearers in the study area include the gray fox, bobcat, coyote, badger, striped and spotted skunk and ringtail cat." These species should be identified by their classification, protected, unprotected, furbearer, etc.

General Comment. Tables 2 & 3 present a good picture of wildlife habitat acreages within the planning unit.

Page 16

Lake trout are not present in this system. Other species found but not listed include cutthroat trout, striped bass, Humpback sucker, Colorado River bonytail chub, Whiteriver bonytail chub, Virgin River spinedace, Woundfin, Colorado River squawfish, Golden shiner, Moapa dace and White River springfish.

Page 17

Statement about White River mountain sucker is not clear. These are currently found in the White River drainage on the Kirch Wildlife Management area.

Page 17b

Pahranagat Lake is not a habitat for protected fish.

Page 23 - 39 Analysis of the Proposed Action

Page 27 - 29

Wildlife impacts in this section are well illustrated.

Page 27 - Paragraph 6

If development and operation occurred on or near historic sage grouse breeding complexes, this species would move out permanently - not just during the development and operations.

Page 28 - Paragraph 2

Accidental spills, seepage, blowouts, would also directly affect losses of wildlife and fish in addition to loss of habitat.

As stated, impact upon fish and aquatic resources can be significant and likely intolerable from the viewpoint of the thermal endangered species involved. Eventhough all possible protection measures are incorporated, a single "accident" will likely result in the extinction of a species.

Evaluation of subsequent geothermal leases must be analyzed on an individual basis.

Page 33

Mitigative measures for wildlife.

Department should recommend replacement of any wildlife species or individuals lost.

NEVADA DEPARTMENT OF FISH & GAME

Comments:

Loss of fish and wildlife populations and habitat can and probably will occur in proportion to amount of land area devoted to geothermal and oil and gas exploitation.

Hunting and fishing and other recreational opportunities can be decreased commensurate with the magnitude of development.

III.A.3.a. Surface and Ground Water
Ponds - Wilson, Feour, Nesbitt Reservoir (lake), Schroedoer Reservoir and Echo Canyon Reservoir.

III.B.2. Wildlife

Under this wildlife section and the appendix for wildlife species, they fail to list antelope. Antelope occur in lower Lake Valley near Pioche seasonally on occasion and also are frequently observed in Sand Spring Valley and to a lesser extent in Tikaboo Valley. The latter two valleys are not now herd units that are hunted, but future inventories will likely portray increased populations and possibly limited hunting will be allowed.

"Furbearers in the study area include the gray fox, bobcat, coyote, badger, striped and spotted skunk and ringtail cat." These species should be identified by their classification, protected, unprotected, furbearer, etc.

General Comment. Tables 2 & 3 present a good picture of wildlife habitat acreages within the planning unit.

Pahranagat Lake is <u>not</u> a habitat for protected fish.

If development and operation occurred on or near historic sage grouse breeding complexes, this species would move out permanently - not just during the development and operations.

Response:

Text has been amended as suggested.

Comments:

III.A.2.d. Land Uses
This section does not put wildlife usage of forage and recreational use (in form of consumptive and non-consumptive) into proper perspective. Mention is made of hunting recreation on the Overton WMA, yet in Paragraph 2, it states that recreation, agriculture and mining

seem to be the major land uses. The wildlife resource value should be shown in terms of hunter use days by species, by county and at least assign the average dollar value of a hunter use day and wildlife observation day. Wildlife resources are in fact a multi-million dollar resource when you consider propulations needed to sustain a given harvest level, forage requirement value and monies expended by recreationists.

Response:

We agree that hunting is a valuable land use and we do not slight it in the EAR. BLM classifies hunting as a form of recreation (which we state is a major land use). Some hunter use data has been added to III.2.e. Socio-Economic Considerations.

Comment: III.B.2. Wildlife

Lake Trout are not present in this system. Other species found but not listed include cutthroat trout, striped bass, humpback sucker, Colorado River bonytail chub, White River bonytail chub, Virgin River spinedace, woundfin, Colorado River squawfish, golden shiner, Moapa dace and White River springfish.

Response:

The woundfin, White Chub (also called Pahranagat bonytail), White River springfish, Virgin River spinedace, Moapa dace were listed in the original EAR as protected, rare or endangered species. The lake trout has been deleted while the other species suggested have been added.

Comment: III.B.2. Wildlife

Statement about White River mountain sucker is not clear. These are currently found in the White River drainage on the Kirch Wildlife Management area.

Response:

While this species may be found on the Kirch Wildlife Management Area, it is no longer present in the Pahranagat Valley Area (in the Caliente Planning Unit) where it was formerly recorded. James Deacon (Associate Professor of Biology) stated in a letter to the Nevada Fish and Game Commission in 1967, that he'd tentatively concluded that this species and the spinedace are extinct in this area.

Comments: IV.A.1.b. Wildlife

Accidental spills, seepage, blowouts, would also directly affect losses of wildlife and fish in addition to loss of habitat.

As stated, impact upon fish and aquatic resources can be significant and likely intolerable from the viewpoint of the thermal endangered species involved. Even though all possible protection measures are incorporated, a single "accident" will likely result in the extinction of a species.

Evaluation of subsequent geothermal leases must be analyzed on an individual basis.

Response:

We agree with that impacts these are possible impacts. We think the EAR reflects these concerns.

Comments: IV.A.2. Wildlife

Mitigative measures for wildlife.

Department should recommend replacement of any wildlife species or individuals lost.

Response:

This recommendation is not very practical. The approach the Bureau is taking is to do everything possible to mitigate adverse impacts on wildlife, thus attempting to prevent losses in the first place rather than trying (probably unsuccessfully) to replace lost species or individuals.

Form 13

425

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

MEMORANDUM

February 20, 1976

To Planning Coordinator
Room 45, Capitol Bldg.

From Program Engineer, Highway Dept.

Subject: Oil, Gas & Geothermal E.A.R. for Caliente-Virgin Valley Resources Area SAI NV #76800044

1976 FEB

The leasing of any area in the Caliente and Virgin Valley Planning Units should exclude areas previously granted for right-of-way and material deposits for the following Federal and State Routes; I-15, US 93, SR 7, SR 12, SR 25, SR 40, SR 54, SR 85 and SR 86.

ILL-MW:lu

HIGHWAY DEPARTMENT

Comment:

The leasing of any area in the Caliente and Virgin Valley Planning Units should exclude areas previously granted for right-of-way and material deposits for the following Federal and State Routes; I-15, US 93, SR 7, SR 12, SR 25, SR 40, SR 54, SR 85 and SR 86.

Response:

A clause discouraging surface occupancy in these areas has been added to the Final EAR. (See IV.A.2.d. and Unique Geographical Areas in the Appendix).

STATE OF NEVADA
DEPARTMENT OF HUMAN RESOURCES
ENVIRONMENTAL PROTECTION SERVICES
CAPITOL COMPLEX
CARSON CITY, NEVADA 89710

February 10, 1976

MEMORANDUM

TO: Bruce Arkell

FROM: Dick Serdoz

SUBJECT: Oil, Gas & Geothermal E.A.R. for Caliente-Virgin Valley Resources Area SAI NV#76800044

Air Pollution (Dick Serdoz): The possible mitigating measures for effect on air quality only required atmosphere monitoring to detect excessive pollution. One very important monitoring program would be to monitor the local meteorology to determine local dispersion characteristics. Second, the existing burden of heavy metals and H_2S contained in the local atmosphere has not been defined. Third, the existing burden of heavy metals and H_2S has not been defined in the existing animal and plant life. Fourth, the impact (injury) concentration of various pollutants has not been defined for the native vegetation of the study area. This is important as H_2S will injure plant life at lower concentrations when the ambient temperature increases. Last, monitoring should be conducted on all new wells to determine the type of discharge that will occur before the well is allowed to blow for cleaning purposes.

The mitigating measures referred to in #8 under soil, I could not find that measure. The highest numbered measure was #7.

On page 23, IV, A.1.a. allows open burning, yet your cover letter prohibited it.

Water Pollution (Wendell McCurry): No comments.

Solid Waste (A. Vandenberg): Page 1 of Attachment 1 (third page of report) and on page 31, pp. 2, under the title of Possible Mitigating Measures, the first line should read: "....the lessee shall comply with Federal, State....", rather than should. Reason: Without this change there would appear to be little control over the ultimate disposal of what might be termed "hazardous wastes". A particular hazardous waste in this category is drilling mud.

Sumps with waste drilling mud must be removed or covered in accordance with local or State regulations.

gm
cc: Frank Holzhauer

STATE OF NEVADA
DEPARTMENT OF HUMAN RESOURCES
ENVIRONMENTAL PROTECTION SERVICES
Capitol Complex
CARSON CITY, NEVADA 89710

February 20, 1976.

MEMORANDUM

TO: Bruce Arkell

FROM: Dick Serdoz

SUBJECT: Oil, Gas & Geothermal E.A.R. for Caliente-Virgin Valley Resources Area EAI NV#76BD004

Air Pollution (Dick Serdoz): The possible mitigating measures for effect on air quality only required atmosphere monitoring to detect excessive pollution. One very important monitoring program would be to monitor the local meteorology to determine local dispersion characteristics. Second, the existing burden of heavy metals and H_2S contained in the local atmosphere has not been defined. Third, the existing burden of heavy metals and H_2S has not been defined in the existing animal and plant life. Fourth, the impact (injury) concentration of various pollutants has not been defined for the native vegetation of the study area. This is important as H_2S will injure plant life at lower concentrations when the ambient temperature increases. Last, monitoring should be conducted on all new wells to determine the type of discharge that will occur before the well is allowed to blow for cleaning purposes.

The mitigating measures referred to in 98 under soil, I could not find that measure. The highest numbered measure was 97.

On page 23, IV, 4.2.a. allows open burning, yet your cover letter prohibited it.

Water Pollution (Wendell McCurry): No comments.

Solid Waste (A. Vandenberg): Page 1 of Attachment 1 (third page of report) and on page 31, No. 2, under the title of Possible Mitigating Measures, the first line should read: "...the lessee shall comply with Federal, State,...", rather than should. Reason: Without this change there would appear to be little control over the ultimate disposal of what might be termed "hazardous wastes". A particular hazardous waste in this category is drilling mud.

Sumps with waste drilling mud must be removed or covered in accordance with local or State regulations.

cc

cc: Frank Holzhauer

ENVIRONMENTAL PROTECTION SERVICES

Comment: Air Pollution (Dick Serdoz)

The possible mitigating measures for effect on air quality only required atmosphere monitoring to detect excessive pollution. One very important monitoring program would be to monitor the local meteorology to determine local dispersion characteristics. Second, the existing burden of heavy metals and H_2S contained in the local atmosphere has not been defined. Third, the existing burden of heavy metals and H_2S has not been defined in the existing animal and plant life. Fourth, the impact (injury) concentration of various pollutants has not been defined for the native vegetation of the study area. This is important as H_2S will injure plant life at lower concentrations when the ambient temperature increases. Last, monitoring should be conducted on all new wells to determine the type of discharge that will occur before the well is allowed to blow for cleaning purposes.

The mitigating measures referred to in #8 under soil, I could not find that measure. The highest numbered measure was #7.

On page 23, IV.A.1.a. allows open burning, yet your cover letter prohibited it.

Response:

Monitoring of local meteorology and existing burdens of pollutants in the air and biota is not within the powers of the BLM. It is properly a state or local responsibility. The best that the BLM can do is require that existing standards as set by the state, county, county or EPA are not violated.

Similarly defining the concentrations of various pollutants for the native vegetation is a State, local, or EPA function.

If a well is "blown" for cleaning purposes the escaped gases must not violate existing pollutions standards, regardless of type of discharge.

Corrections on mitigating measure reference and cover letter have been made for the final.

Water Pollution (Wendell McCurry): No comments.

Comment: Solid Waste (A. Vandenberg)

Page 1 of Attachment 1 (third page of report) and on Page 31, pp. 2, under the title of Possible Mitigating Measures, the first line should read: "...the lessee shall comply with Federal, State...", rather than should. Reason: Without this change there would appear to be little control over the ultimate disposal of what might be termed "hazardsous wastes". A particular hazardous waste in this category is drilling mud.

Sumps with waste drilling mud must be removed or covered in accordance with local or State regulations.

Response:

It is policy to phrase possible and mitigating measures in an EAR with "should" or "could" instead of "shall" or "will", since the EAR is not a decision-making document. Once these measures are incorporated into the cover memorandum (which states the decision made, the rationale behind this decision and recommended stipulations) signed by the Authorized Officer and into the lease these measures are phrased with "shall" or "will".

EIS Reviewed Oil, Gas and Geothermal E.A.R. for Caliente-Virgin Valley Resources Area SAI # NV-#76800044

Reviewing Agency Division of Colorado River Resources

Person/s Preparing Review D. L. Paff/T. F. Whitmoyer

POLICY CONSIDERATIONS

1. **Major direct and secondary impacts on State.** The possibility of new contributions of salinity to the Colorado River system through spills and underground seepage into tributary streams is not addressed. Abandoned oil, gas and geothermal wells or brine and/or contaminates produced therefrom within the Nevada portion of the Colorado River drainage basin could impact on Colorado River tributaries and the River. A prohibition of such potential impacts should be mandatory.

2. **Major indirect impacts on State.**

   The resulting impacts of reducing interior temperatures in the geothermal fields should be addressed. The potential problems, if any, should be monitored and analyzed.

Page for These Comments

TECHNICAL CONSIDERATIONS

3. General comments.

On page 35, third paragraph under item #5, third sentence: "The increased tax base will, in a few years, relieve the strain of the additional residents on nearby communities." Some community planners have discounted this theory.

4. Technical comments

The description of Water Quality on page 11 should be checked in view of the description of the Virgin River TDS levels as 100-300 mg/l. The location and date of the quality levels described should be included.

5. Other specific comments.

Most of the maps in the report are unusable to the reader because of poor reproduction.

6. **Suggested alternatives, remedial actions and/or mitigating measures.**

Under mitigating measures, the word "should" seems to connote permissiveness. If various public laws and directives are studied, such as the Water Pollution Control Amendments of 1972 or the Endangered Species Act, it is evident that "should" is better replaced with "shall" or "must" (Refer to all mitigating measures listed).

DIVISION OF COLORADO RIVER RESOURCES

Comments:

Major direct and secondary impacts on State. The possibility of new contributions of salinity to the Colorado River system through spills and underground seepage into tributary streams is not addressed. Abandoned oil, gas and geothermal wells or brine and/or contaminates produced there from within the Nevada portion of the Colorado River drainage basin could impact on Colorado River tributaries and the River. A prohibition of such potential impacts should be mandatory.

Resources:

This problem was addressed in the water sections of the EAR both in the impact section and the mitigating measures section.

Dikes will be constructed around wells to contain wells, all sumps will be lined, no water will be dumped into washes, abandoned wells will be plugged, etc.

It is felt that these measures will protect the water resources of the area.

Comment:

The resulting impacts of reducing interior temperatures in the geothermal fields should be addressed. The potential problems, if any, should be monitored and analyzed.

Responses:

Geothermal energy is the result of radio-active decay and/or molten rock bodies below the earth's surface. Such heat is considered limitless for all practical purposes.

Appreciable cooling of the rocks below the field is considered highly unlikely. Should it occur, it might involve subsidence due to volume lose due to the contracting cooling rocks.

A much more likely occurrence is seismic activity due to water removal and reinjection.

Comments: IV.A.1.d. Human Components

"The increased tax base will, in a few years, relieve the strain of the additional residents on nearby communities." Some community planners have discounted this theory.

Response:

Other community planners subscribe to this theory. At this point, it is still a "theory". So in the text, "will" has been changed to "may".

Comment:

The description of Water Quality (III.A.3.b.) should be checked in view of the description of the Virgin River TDS levels as 100-300 mg/l. The location and date of the quality levels described should be included.

Response:

This was a typographical error. Virgin River water usually contains 1000-3000 mg/l of dissolved solids. This data was taken from Water Resources--Reconnaisance Series Report 51 on the lower Virgin RIver Valley area (1969). The chemical analyses were made in 1966.

Comment:

Most of the maps in the report are unusable to the reader because of poor reproduction.

Response:

A different technique of reproduction has been attempted for this final EAR.

Comment:

Under mitigating measures, the word "should" seems to connote permissiveness. If various public laws and directives are studied, such as the Water Pollution Control Amendments of 1972 or the Endangered Species Act, it is evident that "should" is better replaced with "shall" or "must" (Refer to all mitigating measures listed).

Response:

Refer to response given to similar comment made by A. Vandenberg (Environmental Protection Services).

N-12574

MIKE O'CALLAGHAN
Governor

STATE OF NEVADA

ADVISORY MINING BOARD

4249 KINGS CANYON ROAD
CARSON CITY, NEVADA 89701
Telephone 882-3534

M. DOUGLAS MILLER
Chairman
882-3534
FRED D. GIBSON, JR.
Secretary
565-8741
PETER E. GALLI
329-1169
JAMES McCARTY
635-2680
J. M. REYNOLDS
573-2232
KENT ROLLINS
573-2335
HOWARD WINN
235-7741

February 9, 1976

Honorable Mike O'Callaghan
Governor
State of Nevada
Capitol Building
Carson City, Nevada 89701

Re: E.A.R., for Caliente-Virgin Valley Resources Area, Oil, Gas & Geothermal SAI NV 76800044
"Comments Memo"

Attention Mr. Bruce Arkell, Planning Coordinator

Dear Sirs:

In reviewing this E.A.Report we wish to encourage the exploration and development of all sources of Energy in every form that will respond and serve the citizens and institutions of Nevada. On July 11, 1975, we responded to SAI Nv. 76800003 on the Ely, White Pine District and we believe the SAI NV 76800026, E.A.R. on Lincoln County Management, Known As the "Beaver Dam" Habitat management plan, should become a part of this report, Mineral policy statement of this Board with regard to the 86 % plus Public Land administering agencies of the Federal Government. The E.A.R. Report made on June 27,1975 on S.A.I. NV 75800035, "State-line" planning area of Clark and Nye Counties, Nevada. All of these E.A.R. reports are concerned with Search and mineral development as well as water and its uses. We oppose any and all withdrawals of Public Lands unless a careful and detailed mineral examination has proven the withdrawal area of 5000 acres or more to be "mineral free". Please refer to our previous E.A.R. reports, these same statements are to be included in the future Environmental impact Statements (E.I.S.) on all Public Lands.

The State of Nevada has a vested interest in all the Lands of Nevada, These lands must be managed to serve all the People under a " Multiple-use" management plan. This cannot be accomplished by "locking up" large areas for single purpose "Wilderness" and "primitive" areas, which will be completely closed to all mineral entry by 1984. This could prove disastrous to Nevada as well as many other States who have a large part of their States under Federal Administration. We must move ahead with thorough mineral, Gas, Oil, Geothermal and Nuclear as well as Solar energy Exploration and forget the endandered species and Emotional Hysteria that has enveloped our National Forests and Bureau of Land Management pressure group planning. There are small areas for Game and Archeological studies and Recreational development that need to be developed by the Federal Agencies but not at the Expense of our State and Nation as it has in the last 10 years in the Renewable and Non-Renewable resource reserves.

Respectfully submitted,

Yours very truly,

M. Douglas Miller, Chairman

ADVISORY MINING BOARD

Comment:

See letter

Response:

This particular EAR does not address withdrawals from mineral entry, therefore, a mineral examination is not appropriate here. This EAR does address oil, gas and geothermal leasing and development and does recommend that certain areas be completely closed to such activities. The Bureau of Land Management does endorse multiple use planning but it is believed that in these few areas (which when the reader looks at the maps provided in the appendix, he can see that these areas--less than 126,000 acres--take up a small percentage of the over 4,600,000 acres in these two planning units) oil, gas and geothermal development would be totally incompatible. In other areas exploration would be encouraged as long as the stipulations (which are geared at promoting use by the greatest number of activities) are adhered to.

SAI NV 76800044

EIS Reviewed: Oil and Gas/Geothermal E.A.R. for
Caliente-Virgin Valley Resources Area

Reviewing Agency: Nevada State Park System

Person preparing review: Nolan F. Keil, Administrator
(State Historic Preservation Officer)

General Comments

A. Historical, Archaeological, and Cultural Resources Identification and Mitigation.

1. There is a very apparent lack of information concerning the present state of knowledge regarding archaeological, historical, and cultural resources within the area effected by this proposal.

2. There are many sensitive archaeological areas known to exist within the area. The Nevada Archaeological survey should be contacted regarding the location of these areas and their recommendations for mitigating possible impacts upon them.

3. The known historical resources should also be listed in order for potential lessees to be aware of those areas where they may be required to accomplish extensive mitigation measures and possibly be prohibited from surface occupancy.

4. The standard stipulations for protection of the environment which are written into all Oil and Gas/Geothermal leases by the Bureau of Land Management, are very specific in their requirements to protect the environment. We note a very decided lack of positive statements in this regard in this EAR.

5. In conclusion, with the information presented, we are unable to make a determination as to the effects this proposal may have on the archaeological, historical, and cultural resources which occur within its area of potential impacts, nor can we properly assess the measures proposed to mitigate possible impacts upon these resources.

B. Recreational Resources

1. The Nevada State Park System had a study conducted in 1972 to determine the potential for state parks in Clark County, Nevada. The report of this study was made available to the Bureau of Land Management, however, there is a lack of reference to these recreation sites within the proposed lease area: Arrow Canyon, Buffington Pockets, Virgin Mountain, Whitney Pockets, and Bitter Ridge.

2. There are several potential recreation and/or scenic resource areas in the Lincoln County portions of the lease area which should be recognized and mitigated. A very important one being the Rainbow Canyon-Kane Springs Wash corridor. The EAR should allow for protection or mitigation of resources such as this.

3. The Nevada State Comprehensive Outdoor Recreation Plan (SCORP) should be consulted for potential acquisition and development sites for outdoor recreation. Over 15 general areas are identified, some of which are not in the EAR.

NEVADA STATE PARK SYSTEM

Comment:

There is a very apparent lack of information concerning the present state of knowledge regarding archaeological, historical, and cultural resources within the area effected by this proposal.

There are many sensitive archaeological areas known to exist within the area. The Nevada Archaeological survey should be contacted regarding the location of these areas and their recommendations for mitigating possible impacts upon them.

Response:

The extent cultural resources inventory for the Caliente-Virgin Valley Resources Area is an extremely limited data base. With the exception of BLM-initiated project specific clearance and inventories there is a marked absence of intensive area surveys (Class 3). Therefore, site-by-site inventories remain the basic source of information for cultural resource data.

Since the BLM and the NAS have duplicate sets of site records the BLM has the capability to delineate sensitive archaeological areas on its own and has already done so for the Caliente Planning Unit.

Prior to authorization of lease, an intensive level cultural resources survey will be conducted insuring adequate assessment of the cultural resource base prior to acceptance of the lease.

Comment:

The known historical resources should also be listed in order for potential lessees to be aware of those areas where they may be required to accomplish extensive mitigation measures and possibly be prohibited from surface occupancy.

Response:

The following are historic sites in the resources area which have been or are being nominated to the National Register of Historic Places:

1) Bunkerville (Bunkerville, Nevada)
2) Panaca Charcoal Kilns (vicinity Panaca, Nevada)
3) Caliente R.R. Depot (Caliente, Nevada).
4) Mesquite House

Comment:

The standard stipulations for protection of the environment which are written into all Oil and Gas/Geothermal leases by the Bureau of Land Management, are very specific in their requirements to protect the environment. We note a very decided lack of positive statements in this regard in this EAR.

Response:

See "Mitigating Measures" for an explicit statement of cultural resources investigations required prior to operations.

Comment:

In conclusion, with the information presented, we are unable to make a determination as to the effects this proposal may have on the archaeological, historical, and cultural resources which occur within its area of potential impacts, nor can we properly assess the measures proposed to mitigate possible impacts upon these resources.

Response:

We agree that there is a lack of adequate information to make a determination as to the effects this proposal may have on the cultural resource base at the present time but, the BLM has an established policy which requires project-specific clearance and inventory prior to any proposed action on National Resource Lands which might pose either a direct or indirect impact on the cultural resource base. Oil and Gas/Geothermal leases are no exception.

In accordance with the BLM Cultural Resource Evaluation System (CRES), each site is assigned a significance rating. If a site is of mid- or high significance (S2 or S1) or cannot be rated without further evaluative data (S0) the established policy is to recommend avoidance of such sites. Low significant sites S3 can be adequately mitigated by sampling or 100% collection.

Therefore, it is a moot point as to whether or not one can make a determination of the effects the proposal will have on the cultural resource base or the mitigation of possible impacts on them because each lease will require a prior cultural resource clearance and inventory in accordance with BLM policy which explicitly outlines evaluative and mitigating procedures.

Comments:

The Nevada State Park System had a study conducted in 1972 to determine the potential for state parks in Clark County, Nevada. The report of this study was made available to the Bureau of Land Management, however, there is a lack of reference to these recreation sites within the proposed lease area: Arrow Canyon, Buffington Pockets, Virgin Mountain, Whitney Pockets, and Bitter Ridge.

There are several potential recreational and/or scenic resource areas in the Lincoln County portions of the lease area which should be recognized and mitigated. A very important one being the Rainbow Canyon-Kane Springs Wash corridor. The EAR should allow for protection or mitigation of resources such as this.

The Nevada State Comprehensive Outdoor Recreation Plan (SCORP) should be consulted for potential acquisition and development sites for outdoor recreation. Over 15 general areas are identified, some of which are not in the EAR.

Response:

See text amendments under "Land Uses", "Possible Mitigating Measures" and "Unique Geographical Areas" (Appendix).

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Oil, Gas & Geothermal Leasing

2. Stages of implementation

Production

3. DISCRETE OPERATIONS: Extraction-Oil & Gas / Transport - Oil & Gas / (Geo.) Power Generation / Vehicle & human activity, maintenance / Waste disposal

Analysis of anticipated, unmitigated impacts

X=degree of impact is unknown

	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS					6. REMARKS
		Extraction-Oil & Gas	Transport - Oil & Gas	(Geo.) Power Generation	Vehicle & human activity, maintenance	Waste disposal	
I. NONLIVING COMPONENTS	A. AIR						
	Climate	0	0	0	0	0	
	Air Quality						
	Dust	X	-L	0	-L	0	Processes & activities involved will
	Gases & vapor	-L	-L	X	-L	X	determine what dust or fumes, (in
							what quantities) will be produced
							during extraction, transportation
							& waste disposal
	B. LAND						chem. & oil spills-soil
	Soil pollution	-H	-H	-L	-M	-H	pollution
	Fragile watershed						
	Erosion potential	-M	-M	X	-M	-X	clearing; land disturbance-erosion
	compaction	-M	-M	X	-L	-L	Movement of men & machines-land disturbance
	Land Uses-crucial w/l primitive areas	-H	-H	-H	-H	-H	All these activities in conflict w/ these land uses
	Hazards						
	Safety (fire, etc.)	-M	-M	-M	-M	-M	
	Noise	-M	-M	-M	-M	0	
	Flood/land subsidence	-H	0	-X	-M	-X	Extraction & reinjection of fluids may affect land subsidence
	C. WATER						
	Water availability	X	0	X	X	H	Affect on water table is unknown; some
							geo. processes may make water reavail-
							able; net effect is unknown.
	Water quality	-X	0	-X	-M	-H	Oil & chem. spills, waste materials,
							etc. will adversely affect water
							quality.
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*	-H	0	-X	-M	-H	Activities-adverse effect on water
							quality-adverse effect on vegetation

(Continued on reverse)

DISCRETE OPERATIONS		Extraction - Oil & Gas	Transport - Oil & Gas	(Geo.) Power generation	Vehicle & human activity, maintenance	Waste disposal	
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS *(Terrestrial)*	0	-H	0	-H	-H	Locally, impacts on vegetation
	C. ANIMALS *(Aquatic)*						
	Endemic fish	-X	-X	-X	-H	-H	Activities-unknown effects on water
	Waterfowl	-X	-X	-X	-H	-H	table & water quality, harassment
	Amphibians, Invertebrates	-X	-X	-X	-H	-H	
	D. ANIMALS *(Terrestrial)*						
	Wildlife	-H	-H	X	-H	-H	Adverse effects on animals them-
	Livestock	-H	-H	X	-H	-H	selves (noise,harassment, etc.) and
	Wild horses & burros	-H	-H	X	-H	-H	habitat (forage cleared, waters
							usurped, cover destroyed)
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES						
	Food cycle, nutrient	-H	-H	X	-H	-H	All ecological interrelationships
	'cycle, pred./prey						within area of activity will be
	relationship, etc.						altered.
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER	-M	-M	0	-M	-M	Aesthetics will be disrupted
	B. SOCIOCULTURAL INTERESTS						
	Cultural resources	0	0	0	-H	-X	most damage occurred during development
	Socio-economic	+M	+M	+M	+M	+M	Employment,revenue from feeding &
							lodging workers,etc. will benefit
							nearby communities

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.

2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.

5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (–) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (–) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.

6. *Remarks* – Enter clarifying information.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Oil, Gas & Geothermal Leasing

2. Stages of implementation

Exploration

3. DISCRETE OPERATIONS

Analysis of anticipated unmitigated impacts

X=degree of impact is unknown

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS: Phase 1-Surveys, mapping	Off-Road Vehicles	Phase 2 - Road Construction	Drilling, Earth Moving	Rehabilitation	6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Climate	0	0	0	0	0	
	Air Quality						
	Dust	0	-L	-M	-L	+M	dust will be raised by men & machines
	Gases & Vapors	-L	-L	-L	-L	-L	internal combustion engines (Machinery, vehicles, aircraft) will add gases and vapors to the atmosphere during exploration
	B. LAND						
	Soil pollution	0	-L	-L	-M	+H	oil or chem.spills can pollute soil
	Fragile Watershed						
	Erosion potential	0	-H	-H	-M	+M	movement of men & machines, clearing roads-damage of watershed
	Compaction	0	-H	-H	-M	+M	
	Land Uses-crucial w/l areas primitive areas	-M	-M	-H	-H	+H	this type of activity conflicts w/ certain land uses
	Hazards						
	Safety(fire, blowouts)	0	-L	-L	-L	0	
	Noise	-L	-L	-M	-H	-L	noise will accompany this operation
	Flood/land subsidence	0	-L	-L	-L	+M	removal of veg. will increase erosion drilling may affect geologic stability
	C. WATER						
	Water availability	0	0	0	-X	+M	drilling may adversely affect water table locally
	Water quality						
	Sediment load	0	-H	-H	-L	+M	damage to watershed-erosion-increased sediment load
	Chem. pollution	0	-L	-L	-L	+M	oil & chem. spills will adversely affect water quality
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	Phreatophytes, algae, etc.	0	-H	-H	-H	+M	Water pollution will damage aquatic plants

(Continued on reverse)

DISCRETE OPERATIONS		Surveys, mapping	ORV Travel	Road Construction	Drilling, earth moving	Rehabilitation	
	COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS *(Con.)*	B. PLANTS *(Terrestrial)*	0	-H	-H	-H	+H	Water & soil pollution, clearing
							roads, drill pads, etc. will destroy
							vegetation locally
	C. ANIMALS *(Aquatic)*						
	Endemic fish	0	-H	-H	-H	+M	Water pollution will adversely
	Waterfowl	-L	-H	-H	-M	+M	affect aquatic animals, activity
	Amphibians, Invertebrates	0	-H	-H	-H	+M	will scare off waterfowl at first
	D. ANIMALS *(Terrestrial)*						
	Wildlife	-L	-H	-H	-M	+M	Water & soil pollution, new roads,
	Livestock	-L	-H	-H	-M	+M	clearing of vegetation, human &
	Wild horses & burros	-L	-H	-H	-M	+M	vehicle activities-harassment of
							wildlife, loss of forage for
							animals
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES Food cycle, nutrient						
	cycles, etc.	0	-H	-H	-H	+M	All the impacts discussed above
							will seriously alter local
							ecological interrelationships
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER	0	-H	-H	-H	+M	Activities will adversely affect
							aesthetics of the area involved
	B. SOCIOCULTURAL INTERESTS						
	Cultural Resources	0	-H	-H	-H	0	Archeol. & historic sites may be
	Socio-economic	+L	-L	+L	+L	+L	disturbed. Some revenue will go to
							nearby communities as a result of
							employment, vehicle maintenance,
							lodging, etc.

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.
2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.
3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.
4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (–) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (–) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. *Remarks* – Enter clarifying information.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Oil, Gas & Geothermal Leasing

2. Stages of implementation

Development

3. DISCRETE OPERATIONS

Analysis of anticipated, unmitigated impacts

X=degree of impact is unknown

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS: Road & Trail Construction	Drilling	Plant & Construction Camp Dev.	Transmission Lines & pipelines		6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Climate						
	Air Quality						
	Dust	-H	-M	-M	-M		dust will be raised
	Gases & Vapors	-L	-M	-L	-L		internal combustion engines, venting wells, etc. - gases & vapors into the atmosphere.
	B. LAND						
	Soil pollution	-L	-M	-M	0		chem.&oil spillls-soil pollution
	Fragile Watershed						
	Erosion potential	-M	-M	-M	-M		movement of men & equipment, drilling,
	Compaction	-M	-M	-M	-M		etc.-land disturbance
	Land Uses-w/o crucial" primitive areas	-H	-H	-H	-H		conflicts w/ those other land uses
	Hazards						
	Safety(fire,explosion,etc)	-L	-L	-L	0		hazards will arise during development
	Noise	-M	-H	-M	0		
	flood/land subsidence	-L	-X	-M	-L		erosion,extraction,reinject.,etc.will affect flood & geologic hazards
	C. WATER						
	1 Water Availability	0	-X	-X	0		effect of drilling on water table, amt. of water use is unknown
	Water Quality						
	Sediment load	-H	-M	-H	X		land disturbance-erosion-sediments
	Chemical pollution	0	-L	-L	0		some increase in dissolved solids, temp., chem. substances.
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*	-H	-H	-H	0		Adverse effects on water availability & quality will affect aquatic plants

(Continued on reverse)

DISCRETE OPERATIONS		Road & Trail Construction	Drilling	Plant & construct camp dev.	Transmission line or pipelines		
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS *(Terrestrial)*	-H	-H	-H	-H		Vegetation will be cleared for
							those operations
	C. ANIMALS *(Aquatic)*						
	Endemic fish	-H	-H	-H	-L		Construction of rds. will increase
	Waterfowl	-H	-H	-H	-L		access to these animals, adverse
	Amphibians, Invertebrates	-H	-H	-H	-L		effects on water availability, and quality & on aquatic plants will
							damage habitat for these animals
	D. ANIMALS *(Terrestrial)*						Human & vehicle activity will affect animals directly (rd. kills harassment, etc.) and their habitat
	Wildlife	-H	-H	-H	-H		(forage & cover destruction, water
	Livestock	-H	-H	-H	-L		usurption, etc.)
	Wild Horses & Burros	-H	-H	-H	-L		
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES						
	Food Cycle, nutrient cycle,	-H	-H	-H	-H		Aquatic & terrestrial ecol. inter-
	pred./prey relationship,						relationships in the areas of
	etc.						activity will be drastically
							altered).
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER	-H	-H	-H	-H		Aesthetics of area will be adversely
							affected
	B. SOCIOCULTURAL INTERESTS						
	Cultural Resources	-H	-H	-H	-H		Uninventoried archeol. & hist. sites
	Socio-Economic	+H	+H	+H	+H		will be damaged.
							Employment, revenue will benefit
							nearby communities

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however,* it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.).*
2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages).*
3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing).*
4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (–) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however,* to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (–) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. *Remarks* – Enter clarifying information.

U.S. GOVERNMENT PRINTING OFFICE 1974 — 781-866

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Oil, Gas & Geothermal Leasing

2. Stages of implementation

Abandonment

3. DISCRETE OPERATIONS

Analysis of anticipated, unmitigated impacts

X=degree of impact is unknown

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS: Earth moving	Removal of plant, men & equipment	Surface reclamation & restoration			6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Climate						
	Air quality						
	Dust	-M	-M	+H			Some dust will be raised by removal of bldgs.,men & equipment; gases
	Gases & vapor	-L	-L	+H			& vapors will come from internal
							combustion engines. Restoration will
							eliminate these impacts
	B. LAND						
	Soil pollution	-L	+L	+H			Removing sources of pollution will aid soil
	Fragile watershed						
	Erosion potential	-L	-L	+H			Cleared area will be subject to wind & water erosion
	Compaction	-L	-L	+H			Compaction will continue as men & machines are moved
	Land Uses-primitive areas crucial w/l "	-L	+M	+M			removal will benefit other land uses; complete rehab. may not be possible
	Hazards-safety(fire,etc.)	-L	-L	0			
	Noise	-L	-L	0			Some noise during dismantling process
	Flood/land subsidence	-L	0	+H			Rehab. will reduce flood hazard
	C. WATER						
	Water availability	0	X	0			Original effect of operation on
							supply is unknown
	Water quality	-L	-L	+H			Sedimentation & chem. pollution may
							continue through abandonment
							activities; rehab. will improve
							conditions
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
		-L	-L	+H			If water pollution continues during
							removal of operations, adverse impact on aquatic plants will continue

(Continued on reverse)

DISCRETE OPERATIONS	Earth moving	Removal of plant, men & equipment	Surface reclamation & restoration			
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)						
B. PLANTS *(Terrestrial)*	-L	-L	+H			Reclamation will attempt to
						restore native vegetation destroyed
						during the development
C. ANIMALS *(Aquatic)*						
Endemic fish	-L	-L	X			If water pollution continues during
Waterfowl	-L	-L	X			dismantling process, w/l will
Amphibians, Invertebrates	-L	-L	X			continue to be affected; restoration
						potential of these animals is not
						known.
D. ANIMALS *(Terrestrial)*						
Wildlife	-L	-L	+H			
Livestock	-L	-L	+H			
Wild horses & burros	-L	-L	+H			
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Food cycle, nutrient cycle, pred./prey relationship, etc.	-L	-L	+H			
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER	-L	-L	+H			
B. SOCIOCULTURAL INTERESTS						
Cultural resources	0	0	0			
Socio-economic	0	-H	0			

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.

2. *Stages of Implementation* – Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.

3. *Discrete Operations* – Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.

4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.

5. *Anticipated Impact* – Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (–) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (–) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked *"O"* or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.

6. *Remarks* – Enter clarifying information.

☆U.S. GOVERNMENT PRINTING OFFICE 1974 — 781-866

PROPERTY OF
Bureau of Land Management
D S C LIBRARY